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THE

ROYAL ENGINEER.

BY THE

Right Hon. Sir Francis B. Head, Bart.

Enter some, bringing in the Clerk of Chatham.

Smith. The clerk of Chatham: he can write and read, and cast accompt.

Cade. Here's a villain! - - Away with him, I say: hang him with his pen and inkhorn about his neck. [*Exit one with the clerk.*]

SECOND PART OF HENRY VI., *act* iv. *scene* 2.

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LONDON:
JOHN MURRAY, ALBEMARLE STREET.
1869.

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LONDON : PRINTED BY W. CLOWES AND SONS, DUKE STREET, STAMFORD STREET,
AND CHARING CROSS.

TO

THE BRITISH ARMY,

THIS VOLUME,

SHOWING THE NECESSITY OF ENLISTING, AS ITS FUTURE GUIDE TO VICTORY,

BOTH IN ATTACK AND DEFENCE,

SCIENCE,

IS RESPECTFULLY,

BY AN OLD RETIRED COMRADE,

Dedicated.

PREFACE.

FORTY-THREE years ago, seeing before me no chance of advancement—on the French principle of "*reculer pour mieux sauter*," I retired from the corps of Royal Engineers, after an apprenticeship in it for fourteen years.

During rather more than a quarter of a century I had no communication whatever with it, and then only for a few days (in compliance with the request of General Sir John Burgoyne), to instruct its mounted Train in the application of the South-American system of lasso-draught.

When eighteen more years, one after another, had rolled head-over-heels over Time's cataract, during which time I had not the slightest communication with the corps, it resolved to give an honorary dinner to its East-Indian brother-officer, the Abyssinian General. And as, during my retirement, I had written 'The Life of Bruce, the African Traveller,' and consequently had watched with especial interest Sir Robert Napier's campaign, I made an application, in reply to

which I received an official printed letter permitting me to join in the subscription for the proposed dinner, which I accordingly attended, as also, on the following day, some important "siege operations." And there, for the first time in my life, I saw and was introduced to General Frome, the Inspector-General of the Corps of Royal Engineers, and to Major-General Simmons, C.B., the "Director of its Establishment for Military Instruction" at Chatham.

In a short "Memorandum," published by me (dated 7th August last), on the subject of Lord Napier's Campaign (see Appendix B), I had ventured to demonstrate that our army—especially for defence—must henceforward submit to be directed by a man of science; but as the English public—generally speaking—really do not know what Military Science is, I resolved to apply for official permission to ascertain, and to make known—as accurately as I could measure it—how much or how little of that article we possess.

The following correspondence on the subject—which I have been permitted to publish—will speak for itself:—

I.

"Croydon, August 22nd, 1868.

"My dear General Frome,

"If you see no public objection to my going over the Royal Engineer Establishment at Chatham, and taking notes of its proceedings, in the same way as some years ago, by order of Her Majesty's Postmaster-General, I was enabled to describe the interior management of the London General Post Office, I should feel obliged if you would be so good as to supply me in such way as you may think proper with an order to that effect.

"I feel it would not be proper for me to go to Chatham for the purpose I have mentioned without your knowledge and approval.

"I have the honour to remain

"Yours very faithfully,

"F. B. Head,

"late Captain Royal Engineers."

II.

"War Office, Aug. 22nd, 1868.

"My dear Sir Francis,

"I can see no possible objection to your making notes of the system of education at the Royal Engineer Establishment, Chatham, and shall personally rejoice at your taking the matter in hand.

"I will therefore write at once to the D.-A.-General, and ask him to send a Memorandum to M.-General Simmons,

the present Director, and also to let you know either from himself or through me.

"I look upon the School of Instruction as so practical and excellent, that I feel truly glad its description should fall into such hands as yours.

"Yours very faithfully,

"Edw$^{d.}$ C. FROME."

III.

From the Deputy-Adjutant-General.

"Royal Engineers, Horse Guards,
"27th August, 1868.

"MY DEAR GENERAL SIMMONS,

"The Adjutant-General has approved of Sir Francis Head visiting the Royal Engineer Establishment.

"Will you write a line to Sir Francis Head, and invite him to come.

"Yours sincerely,

"J. F. BROWNE."

With this authority I proceeded to Chatham; and, in compliance with my request, General Simmons—who, I may observe, entered the corps after I had left it—billeted me in two comfortably-furnished barrack-rooms, vacated by an officer absent on sick leave.

Of the 112 Engineer officers under his command I was totally unacquainted with all; and as more than nine-tenths were young ones, undergoing

their course of instruction, we had no time to hold any communication with each other.

General Simmons gave me, without a moment's hesitation, in every way, all the assistance I could possibly desire. He conducted me himself over a small portion of the establishment of which he is virtually the Governor; but as the greater part of my time was occupied in committing to very short-hand writing what was before my eyes, and as he had innumerable claims on his time, he —generally speaking—handed me over to the officers of Engineers in charge of the various departments, who, besides laying before me whatever statistics I required, and instructing me with great intelligence, very liberally allowed me—whenever I chose—to diverge from them, to question, and, in return, to obtain useful knowledge from, the non-commissioned officers and sappers, who, besides the young officers of Engineers, were studying in their respective halls.

For four days, of eight hours each, and for three hours of the fifth day,* I was intently occupied in the duty I had undertaken, and in

* As to many people this amount of time may appear insufficient, I venture to state that it took me exactly four days (including travelling over the whole line) to make notes sufficient for my published description ('Stokers and Pokers') of the London and North-Western Railway.

less than half an hour after I had closed my second note-book I drove from Brompton Barracks, by myself, to Chatham Railway Station, and proceeded by the 1·25 P.M. fast train to London.

In submitting to the public—verging on my seventy-seventh year—a very rough sketch of what I witnessed, with a few observations and reflections thereon, I feel very strongly that, if my appraisement of a national establishment which I voluntarily undertook to estimate for the public at its true value should prove to be partial, exaggerated, or incorrect, I shall stand in the world destitute of excuse.

CROYDON,
January 1, 1869.

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THE ROYAL ENGINEER.

PART I.

THE ENLISTMENT AND EDUCATION OF A "GENTLEMAN CADET."

UNTIL 1855 the Master-General of the Ordnance, in addition to a salary of 3000*l.* a-year, enjoyed the perquisite or privilege of feeding the Royal Military Academy at Woolwich with as many cadets as war, pestilence, or other causes might require—in fact, while lads were paying premiums or purchase-money for admission into other professions, civil as well as military, he had at his sole disposal—as a free gift—admission, after due examination and competition, to every first commission in the Royal Regiment of Artillery, and Corps of Royal Engineers.

Some people thought, and even said, that a nobleman or statesman of such high position in the Constitutional Government of the country was *not at all*—and some people thought, and even said, that he was *very*—likely to abuse the patronage thus intrusted to him.

But whether he abused it or not, it is evident that, in either case, abstract merit would be "very

likely" to fall to the ground; and, accordingly, there can exist no doubt that—generally speaking—cadets obtained admission as competitors for the two scientific branches of our army, not so much in virtue of their own abilities, as by the influence, moral or political, of a male or female patron, invisible to the public, who might possibly be careless, ignorant, or both, of the requirements necessary for either corps.

On the 25th of May, 1855, the fatal day of the abolition of the Ordnance Office,* the Master-General, with his salary and his patronage, his Lieutenant-General, his Surveyor-General, his Treasurer, and his Clerk, were altogether as suddenly swamped, as are cattle in Holland when "the pressure-from-without" of the wide wide sea—*sans* warning—carries towards them, as an unwelcome gift, the bank of the verdant meadow in which they are either grazing, or, after grazing, placidly chewing the cud.

And in lieu of the old system, Parliament, after a due period of gestation, gave birth to a new

* The first Master of the Ordnance was hatched about 1414. He had a small ordnance staff under him, with which he served at the siege of Harfleur, battle of Agincourt, &c. This Master of the Ordnance was also Master of the Works, a title equivalent in after times to that of Chief Engineer.

The date when the Master-General, with a Board under him, was constituted, has not been traced. But it is believed that the Master-General and Board acted, as in late days, from the time of Elizabeth. The Office of Ordnance is supposed to have been constituted about 1597.

one, which, with respect to patronage as above described, was exactly as different from that which it was to supersede, as a black baby is from a white one. Its principles were, and by authority are, explained and promulgated by orders officially printed and circulated in pamphlet form, of which the following are extracts :—

HORSE GUARDS, 1*st January*, 1867.

Regulations for the Admission of Gentlemen Cadets to the Royal Military Academy, Woolwich.

N.B.—All Candidates for Commissions in the Royal Artillery and Royal Engineers are required to go through a course of instruction at the Royal Military Academy.

I. Competitive Examinations for admission are held in London twice a year, in January and July. They are conducted by Examiners appointed for the purpose, in the presence and under the superintendence of the Council of Military Education.

The Candidates must be between 16 and 19 years of age.

VIII. Any gentleman who wishes to present himself at one of the Half-yearly Examinations, must send in his name to the Military Secretary at the Horse Guards one month before the time of Examination, forwarding with his application to be noted the following papers :—

1st. An extract from the Register of his baptism, or, in default of that, a declaration before a magistrate, taken by one of his parents, giving his exact age.

2nd. A Certificate of good moral character, signed by a clergyman of the parish to which he belongs, and by

the tutor or head of the school or college at which he has received his education for at least the two preceding years, or such other proof of good moral character as will be satisfactory to the Commander-in-Chief.

IX. The Candidates will be inspected by military surgeons on the first day of the examination, in order that it may be ascertained that they are free from any bodily defects or ailments calculated to interfere with the performance of military duties.

Extreme short-sight, or any serious defect of vision, is regarded as a disqualification.

As soon as, by the above prescribed examination, the *out*sides of the candidates have been ascertained to be sound wind and limb, and free from blemish, their *in*sides are thus very severely tested :—

II. The admissions will be determined by the result of the examination, the subjects of which will be as follows, viz :—

			Marks.
1. Mathematics	Pure	Section I. Arithmetic, Algebra, Euclid, Plane Trigonometry 2,000	3,500
		Section II. Spherical Trigonometry, elements of Co-ordinate Geometry, and of the Differential and Integral Calculus . . 500	
	Mixed :—Statics, Dynamics, and Hydrostatics 1,000		
2. English Language and Composition			1,000
3. History of England, its Dependencies and Colonies			1,000
4. Geography (Modern)			1,000
5. Classics	Latin Language		1,500
	Greek ditto		1,500
6. French Language			1,000

7. German Language	1,000
8. Hindustani ditto	1,000

The examination in French, German, and Hindustani will include writing from dictation.

9. Experimental Sciences, *i.e.* Chemistry, Heat, Electricity, including Magnetism	1,000
10. Natural Sciences, *i.e.* Mineralogy and Geology ..	1,000
11. Drawing { Free-hand Drawing of Machinery, Architectural, Topographical, Landscape, or Figure Subjects .. .. }	1,000

Every Candidate must qualify in Geometrical Drawing; *i.e.* Drawing in Ink, with accuracy, neatness, and to scale, the several Problems of Euclid.

Considering that lads between sixteen and nineteen to be examined as above, "in the presence and under the superintendence of the Council of Military Education," are candidates, not for commissions, but merely for admission into an academy in which they are to be permitted to *begin* to study for their commissions, it would at first appear that the preliminary large amount of knowledge required (as above detailed) was amply sufficient.

However, for reasons, the wisdom of which I will endeavour to explain, a still larger amount is required.

The prize of free commissions offered by Parliament to be competed for by the sons of the community at large is so valuable, that the country is entitled, in return for these gifts, to obtain for the two scientific branches of its army the very

best article which the market, when duly tested, is willing to supply.

Supposing, therefore, that the object of the competition was merely to obtain active, athletic young men, it is obvious that the higher the youths were required to jump, the faster they were made to run, and the heavier the weights they hurled or lifted, the more valuable would be the results of the contests.

And, in like manner, where the object of the competition is to obtain for Her Majesty's Service quick active minds, combined with stout reasoning faculties, a large amount of knowledge is required, not for its intrinsic value, but to attract candidates of high mental capacity.

Proceeding, therefore, on this shrewd mercantile principle of raising the price of a commodity in proportion to its demand, the Horse Guards, on the last page of their pamphlet, conclude their list of requirements by the following one, which,—just as a large, lean, savage dog, tethered to a tree of rosy-cheeked apples, is said by gardeners to be "*good for keeping off boys*,"—must inevitably have the effect of frightening from the competitive examination every idle, inattentive, pleasure-loving lad, be he ever so good-looking. Indeed, it really is, in the words of Sam Slick, "*a caution for an owl.*"

SYLLABUS OF EXAMINATION IN THE DIFFERENTIAL AND INTEGRAL CALCULUS.

Differential Calculus.

The meaning of Differentiation.

The Differentiation of Elementary Functions of one independent variable.

The theorems of Taylor and Maclaurin, with their applications.

The theory of Maxima and Minima, with its applications.

The equations to the Tangents, Normals, and Asymptotes of Plane Curves.

The curvature of Plane Curves and their radii of curvature and evolutes.

The Differential Co-efficients of the Arcs and Areas of Plane Curves to rectangular and polar Co-ordinates, and of the surfaces and volumes of solids of revolution.

Integral Calculus.

The meaning of Integration.

The Integration of Elementary Functions.

The Integration of Rational Fractions.

The determination of the lengths and areas of Plane Curves, and of the surfaces and volumes of solids of revolution.

But an owl, especially by sunshine, is much easier terrified than an eagle, and in like manner on youths of a higher class of intellect the above requirements have no deterring effect. On the contrary, the attractions of the national prize have, on the whole, proved to be so much stronger than the terrors of the examination, that, for only forty vacancies offered to the whole community, as many as 100, 150, and even 200 candidates

have simultaneously stepped forward; and as, in their examination, favouritism is unknown, and interest *nil*, the cream of the whole mixture is, in the manner described in the following official document, every half-year skilfully skimmed off by the Horse Guards, and for the use and great benefit of Her Majesty's Service despatched to the Royal Military Academy at Woolwich:—

REPORT.

THE COUNCIL OF MILITARY EDUCATION have the honour to submit to His Royal Highness the Field-Marshal Commanding-in-Chief, the following Report of the Open Competitive Examination for Admission to the Royal Military Academy, Woolwich, which was held at the Royal Hospital, Chelsea, in July, 1868.

The Examination commenced on Wednesday the 1st, and was continued according to the following arrangement:—

Wednesday, July	1	..	Medical Examination of Candidates.
Thursday	„ 2	Morning—Geometrical Drawing. Afternoon—French.	
Friday,	„ 3	Morning—Landscape Drawing. Afternoon—French.	
Saturday,	„ 4	Morning—Mathematics. Afternoon—English.	
Monday,	„ 6	Morning—Mathematics. Afternoon—English.	
Tuesday,	„ 7	Morning—Mathematics. Afternoon—History.	
Wednesday,	„ 8	Morning—Mathematics. Afternoon—History.	

Thursday,	July	9	Morning—Mathematics. Afternoon—Geography.
Friday,	„	10	Morning—Mathematics. Afternoon—Geography.
Saturday,	„	11	.. Latin.
Monday,	„	13	.. Greek.
Tuesday,	„	14	.. German.
Wednesday,	„	15	.. Experimental Sciences.
Thursday,	„	16	.. Natural Sciences and Hindustani.

The number of Candidates who presented themselves on the first day was 144; of whom one was rejected by the Medical Board, and two others subsequently withdrew; of the remainder 57 were found qualified in every respect, and the names of the 40 highest on the list were submitted to His Royal Highness the Field-Marshal Commanding-in-Chief, on the 23rd July.

Every cadet is liberally granted by his country a specified pay per day, which, as will appear from the following extracts, amounts, with certain exceptions, to exactly 125*l.* a-year less than nothing:—

REGULATION VII.—Each Cadet on joining will be required to pay a sum of 25*l.* to cover the expense of Uniform, Books, &c. He will also be required to pay a contribution of 62*l.* 10*s.*, payable in advance, for each half-year of the time during which he remains under instruction.

The annual contributions, however, for sons and orphans of Naval and Military Officers will be regulated at the following rates, as heretofore:—

	£
For sons of Admirals and of Generals having Regiments	80
For sons of Generals without Regiments	70

	£
For sons of Captains and Commanders of the Navy, and of Colonels and Regimental Field Officers of the Army	60
For sons of all Officers of the Army and Navy under the above Ranks	40
For sons of Officers of the Army and Navy who have died in the service, and whose families are proved to be left in pecuniary distress	20

DISTRIBUTION OF THE PAY OF A GENTLEMAN CADET IN THE ROYAL MILITARY ACADEMY, WOOLWICH.

	£ s. d.	£ s. d.
Pay at 2*s.* 6*d.* per diem	——	45 12 6
Messing at 2*s.* for 280 days	28 0 0	
Washing for 40 weeks	4 0 0	
Hair-cutter	0 4 6	
Subscription to Library 1*s.* per month	0 12 0	
Balance applicable to several expenses, such as Housekeeper's Salary, Servants' Wages, keeping up Class Books, Drawing Materials, Repair of Clothing, and other contingencies	12 16 0	
	45 12 6	45 12 6

Every cadet, on joining the Royal Military Academy, is designated "*a recruit*," in which grade, especially deemed inferior by his comrades, "like the lobster in boiling water restless and never satisfied," he remains under the zealous

tuition of a steady, highly intelligent, sharp, smart drill-serjeant for about four months, when, the anguish of his preliminary education being over, he is ordered "to join the ranks," where, unentitled to wear any weapon but a bayonet, he, in every respect, acts the part of a private soldier, unless, or until, by "steadiness" and good conduct, he may become one of the few declared in public orders to be "promoted to the rank of Corporal, and to be obeyed as such."

During the whole of their residence at the establishment, the infantry drill of the cadets, under strict but very considerate instruction, advances from simple goose-step to manual and platoon drill, to battalion drill, and even to brigade drill; they occasionally taking their place on garrison field-days as infantry.

Their education, the details of which, though highly interesting and important, might possibly weary the general reader, may be very briefly described to him by the following list of the illustrious personage, experienced officers, and learned professors, who either govern the whole, or the particular study which it is the important duty of each to superintend :—

ROYAL MILITARY ACADEMY AT WOOLWICH.

Governor	Field Marshal *H.R.H. The Duke of* Cambridge, *K.G., G.C.B., K.P. G.C.M.G.* Gren. Guards.
Lt.-Gov., Commandant	Maj.-Gen. John Wm. Ormsby, R. Art.
Insp. of Studies, 2nd Commandant	Lt.-Col. Geo. Thos. Field, R. Art.

Assist. Insp. of Studies	Capt. E. J. Bruce, R. Art.
Captains of Companies of Gentlemen Cadets	Capt. Oliver R. Stokes, R. Art. 2nd Capt. Chs. Vaughan Arbuckle, R.A. Bt. Lt.-Col. Geo. A. Milman, R. Art.
Lieutenants of Companies of Gentlemen Cadets	Frank Johnson, R. Art. A. B. Cunningham, R. (*late* Beng.) Art. G. J. Burgmann, R. Art.
Chaplain	*Rev.* A. C. Fraser.
Paymaster and Adjutant	Chas. South, *m.*
Quartermaster	G. A. Shepherd, R. Art.
Surgeon	E. S. Protheroe, R. Art. (*Surg. Maj.*)

CIVIL BRANCH.

Professor of Mathematics	J. J. Sylvester, *Esq.*, *M.A.*, *F.R.S.*
Professor of Fortification	Capt. J. J. Wilson, R. Eng.
Professor of Artillery	Bt. Lt.-Col. C. H. Owen, R. Art.
Professor of Mechanics	T. M. Goodeve, *Esq.*
1*st Mathem. Mast.*	Stephen Fenwick, *Esq.*, *F.R.A.S.*
2*nd Mathem. Mast.*	*Rev.* G. Y. Boddy, *M.A.*
3*rd Mathem. Mast.*	Wm. Rae ster, *Esq.*
4*th Mathem. Mast.*	Morgan W. Crofton, *Esq.*
Instructors in Fortifications	Bt. Maj. W. J. Stuart, R. Eng. Capt. C. N. Martin, R. Eng. Capt. E. L. Bland, R. Eng. 2nd Capt. H. F. C. Lewin, R. Eng.
Professor of Geometrical Drawing ..	Thos. Bradley, *Esq.*
Masters for Geometrical Drawing ..	G. S. Pritchard, *Esq.* F. Bradley, *Esq.*
Masters for Landscape Drawing ..	Geo. B. Campion, *Esq.* A. Penley, *Esq.*
Instructor in Artillery	2nd Capt. O. H. Goodenough, R. Art.
Assist. Instructors in Artillery ..	2nd Capt. H. W. Briscoe, R. Art. 2nd Capt. H. Brackenbury, R. Art.
Professor of Military History	
Professor of Surveying and Topographical Drawing	Bt. Maj. A. W. Drayson, R. Art.
Assistant Instructors in Surveying and Topographical Drawing	2nd Capt. G. A. Crawford, R. Art. Capt. A. H. Hutchinson, R. Art. Capt. F. E. Pratt, R. Eng. Lt. W. H. Collins, R. Eng.
Professor of French	Alphonse Lovey, *Esq.*
French Masters	Theodore Karcher, *Esq.*, *LL.B.* Edmund Valentin, *Esq.*

Professor of German	C. A. Feiling, *Esq.*
German Masters	F. Schlutter, *Esq.* C. H. Schaible, *Esq.*, *Ph. D.*, *M.D.*
Professor of Hindustani	Maj. R. Robertson, ret. Ind. Army.
Lecturer on Chemistry	C. L. Bloxam, *Esq.*
Clerk	William M'Gee, *Esq.*

Of the above squad of studies, those which very properly are the most severely insisted on are mathematics, fortification, and artillery; which latter embraces gun and mortar drill, with the actual practice of both; standing drill with garrison guns of the larger calibres in battery; instruction and attendance at all the manufacturing establishments in Woolwich Arsenal.

Visits to Shoeburyness, to Enfield, and also to Waltham Abbey, to learn the manufacture of gunpowder, each cadet being required to make copious notes, with drawings of the machinery, which are examined and credited according to their merit at his final examination.

The course of fortification teaches minutely the German and other modern systems, the cadets themselves executing field-works, as also field-surveying, contouring, sketching, and reconnoitring, in all of which they are sedulously instructed.

As regards modern languages, every cadet is obliged to learn French, but if, as is very rarely the case, he prefers Hindustani to German, he is not required to study the latter.

In attending the lectures on mechanics, geology, mineralogy, and chemistry, each cadet is required

to take notes (which are afterwards written out fair, and submitted to inspection), and at the conclusion of each lecture he is examined in it before he leaves the theatre, attached to which there is an excellent chemical laboratory, where all are practised. The lecturer, moreover, with unsatiated appetite, encourages and takes great interest in voluntary attendances, in which many of his pupils become good manipulators.

All the cadets, most properly, go through a course of riding, and, as already stated, of every description of drill—infantry and gun. All are required to attend as acrobats, at the gymnasium, for the first year, whether they like it or not, afterwards voluntarily.

For recreation between their studies, they have cricket, football, quoits, an American bowling-alley, a workshop for turnery and joinery, two first-rate raquet-courts, covered in; billiard-tables, bagatelle-tables, and, lastly, a nasty smoking-room, with, *per contrà*, a bathing pond, with also baths in each of their division barracks.

Their dietary is abundant,—their beverage, Inde and Coope's beer, brewed in March and October, *on purpose for them*.

Those cadets who have friends in the neighbourhood are permitted to go to them, "on leave," from Saturday at 3 P.M. till Sunday at 11 P.M.

Each has two suits of uniform given to him per year, so that his payment of the highest rate of

contribution (125*l.* per annum) is not, after all, a very bad investment, seeing that at the end of two years and a half, in return for advances amounting to 312*l.* 10*s.*, he has received a first-class education, has been fed, clothed, lodged, warmed, amused, and finally—on the top of all—presented, in a scientific corps, with a commission, for which, had he gone into the line, he would have been charged by his country for the privilege of fighting for it 450*l.*

It appears from the foregoing rough sketch that, during their residence at the academy, the cadets, besides a costly education, daily pay, &c., are provided by Government—that is, by the public—with a most liberal supply, or rather mixture, of amusements of almost every description; and as monarchical government, and, indeed, every other description of government, is based on the principle that he who receives from it protection owes to it allegiance, it follows that any set of students, and especially a litter of young sucking soldiers, are bound, and, if necessary, should be compelled, not only to obey the orders of their superiors, but, without murmur, to submit to punishment if they *dis*obey them.

Now, the four military punishments which for ages had been inflicted on insubordinate cadets, at the old Royal Military College at Great Marlow (which I entered exactly sixty-one years ago), at Sandhurst, and at the Royal Military Academy at

Woolwich Arsenal, and afterwards, when it was removed to its present site on the Common (I was a cadet at both), were drill, arrest, (that is confinement to his bed-room), black hole, and expulsion.

A beloved son, however, of that well-known and universally respected "fine old English gentleman" *Paterfamilias*, having lately, in the Woolwich Academy aforesaid, been subjected to the penultimate of these four punishments, such a quantity of indignation letters—just as toadstools start up in a swamp—managed to appear in the broadsheets of our newspapers, that Government, finding themselves not in a "muddle," but simply in a puddle, assailed by a tremendous storm, deemed it advisable to tranquillise both, by abolishing the sable punishment which *Paterfamilias*—majestically shaking his head—and his supporters, stamping their feet, had declared, and had therefore, they conceived, proved, "gentlemen cadets were too old to undergo."

Now, my own experience, my own reflection, I must say, have taught me that there is no punishment more harmless and more wholesome for a "gentleman cadet" than solitary confinement for twenty-four or forty-eight hours, on bread and water, in the "black hole."

It does not, as *Paterfamilias* and Co. may think, discolour the culprit's skin, nor raise on any portion of it either short weals or little red

pimples. It does not cause a recumbent position to be uneasy, or make it at all uncomfortable to him to sit down. It simply, without inflicting any bodily suffering, deprives him of sunshine, of "Ind and Coope's beer, brewed on purpose for him," of the cheery faces of his comrades, and, accordingly, left entirely to himself, with nothing in the whole world to do or look at, it forces him to think. And his reasoning faculties, strengthened by his mathematical studies, soon demonstrate, or, at all events, under the cold-water cure, have a fair opportunity of demonstrating to him, that he had acted insubordinately,—that his animal spirits had raised him in his own estimation a peg or so too high,—and thus he may, and I believe often does, gradually comprehend in darkness what he had failed to see in broad daylight, namely, the justice as well as the necessity of the long-established proclamation of his, as well as of everybody's, lieutenant-governor :—

"MEUM EST CORRIGERE NEFAS, ET DEBELLARE SUPERBOS."

In reply to the new *theory* which forbids a cadet to be deposited in solitary confinement, it may be asked upon what reasoning should he—wearing a bayonet, and being himself a delinquent—be prevented during his military education, paid for by the public, from learning, and from practically feeling, *one* only of the list of soldier punishments

which, when an officer, he will have power to inflict? And again, if, within the precincts of our barrack squares, at the period in question, were occasionally to be heard the faint, almost suppressed moans of a veteran soldier, suffering, but manfully enduring, corporal punishment,—upon what principle of justice or common sense could a beardless youth of eighteen, equally subject to military discipline, be declared to be not, as many people would expect, too *young*, but TOO OLD (!) to be punished? But the extraordinary fact is that the practical effect of the present alteration is, to increase instead of diminish the amount of the cadet's punishment, or, to use a commoner expression, to throw him "from the frying-pan into the fire." To shield him, while a lad, from an imaginary disgrace, lasting only a few hours, and, after all, known only to his comrades, he is, by rustication, now branded with a public disgrace, which not only, for many months, maims and dislocates his education, but which, if he be sensitive, haunts him through life, and, whether he be sensitive or not,—by the actual loss of steps in a seniority corps caused by others having, during his rustication, risen over his head,—lasts till his death.

But it will appear from the following extract from the official pamphlet already quoted that the *hobgoblin* Paterfamilias has, moreover, inflicted a pecuniary fine upon the *real* Paterfamilias,—that is, the father of the rusticated youth.

REGULATION VII.—If a Cadet be absent a whole term in consequence of sickness or rustication, a payment of 10*l.* will be required for the privilege of his name being kept on the rolls of the establishment, and for a vacancy being guaranteed at the commencement of the next term.

If rusticated during a term, the daily pay will cease from the date on which the Cadet is sent away, and the contribution made for the half-year * will be forfeited.

The simple, obvious, and effectual prescription for correcting the error that has inadvertently been committed, would be to include henceforward in the surgeon's preliminary examination of every candidate for admission into the Royal Military Academy at Woolwich, what should be advertised in the official pamphlet of Regulations as "*the black-hole test*," for which the candidate, according to his success in undergoing it, should receive "marks" similar to those designating different proficiencies in mathematics, astronomy, &c. In which case, should the surgeon, on the other hand, report a candidate as "too delicate" to be black-holed, the defect, like imperfect limbs, feet, hearing, or eyesight, should cause him to be rejected, as unfit to be exposed in daylight and darkness to rain, wind, sleet, frost, and snow; and as incapable before the enemy, either in the field or in the trenches, to encounter cheerfully the blows, heavy

* "The contribution" is half-yearly from 62*l.* 10*s.* to 10*l.*, according to the regulated rates already detailed.

and light, inflicted upon the soldier by the rough, rude, hard hand of war.

The course of studies which has been detailed is sedulously by the professors, and usually zealously by the cadets, continued for the regulated period of two years and a half.

EXAMINATIONS.

The final examination for commissions (as also for progressive advancement from one class to another), which takes place half-yearly (June and December), is exclusively under the Council of Military Education, of which H.R.H. the Duke of Cambridge is president. No member of the Royal Military Academy, from the Lieut.-Governor downwards, has the slightest control over it. Special examiners from our universities, as well as from the artillery and engineers, are appointed by the Council for every separate subject.

The questions drawn up by them to be put before each cadet are previously submitted to the Council, who, on approval, forward them to the authorities of the Royal Military Academy, *confidentially*, arranging, as an additional precaution, that they shall not reach them until the hour at which the examinations actually begin. The important subjects of these examination papers for June last (now before me, and which form a printed octavo volume of 228 pages) will briefly be explained by its preliminary page of

CONTENTS.

FIFTH CLASS.*	Mathematics.
	Practical Geometry.
	French.
	German.
	Hindustani.
FOURTH CLASS.	Mathematics.
	Fortification.
	Practical Geometry.
	French.
	German.
	Hindustani.
THIRD CLASS.	Mathematics.
	Fortification.
	Topographical Drawing.
	French.
	German.
	Hindustani.
SECOND CLASS.	Fortification and Siege Works.
	Artillery.
	Surveying.
	French.
	German.
	Hindustani.
	Mechanics.
	Natural Philosophy.
	Elementary Chemistry.
FIRST CLASS.	Fortification and Field Works and Bridges.
	Artillery.
	Surveying.
	Mechanics.
	Natural Philosophy.
	Applied Chemistry.
	Military History and Art of War.

* The lowest class.

Before the examinations begin, the cadets in each hall are so placed that they cannot copy or receive any oral assistance from each other.

As soon as each succeeds in digesting as many of the hard, tough questions in each paper as he can manage to swallow, he takes his written answers or solutions to the examiners of each subject, who, when all those distributed are collected, designate their absolute and comparative value, by attaching to each *marks*, or numbers, according to their merit.

The whole of the papers thus "marked" are then submitted to the Council, who, by collating them, are enabled to award to the owner of the highest number of marks the highest place, and downwards, in gradation, throughout the total number of cadets examined. This list, to which is appended the professor's reports of proficiency, conduct, &c., is prepared by the Council, and kept by its Vice-President *in the strictest confidence*, until what is called the "Public Day," at which H.R.H. the Duke of Cambridge has given notice that he will preside. At his appointed hour the whole of the cadets, under arms, on the parade in front of their barracks, and usually in the presence of many officers and visitors of distinction, receive His Royal Highness with a royal salute (at which ceremony I was lately permitted to be present).

After minutely inspecting them, the Commander-in-Chief himself selected and ordered one of the

"cadet-under-officers" (one grade above that of "cadet-corporal") to drill the battalion in his presence, from manual and platoon to battalion evolutions. He then inspected them at gun and mortar drill—field and garrison,—after which they marched to their *salle d'armes*, where there was sufficient space for them all to be formed.

The Duke, having here taken his place on a daïs, in front of a table on which were laid out all the prizes, about twenty in number (the two of highest honour being a sword for general good conduct, and the Pollock gold medal), the Vice-President of the Council, opening his Report, proceeded to read it to the Duke, as also a list of the cadets, arranged in precedence, according to the number of "marks" which each, at his examination, had attained.

When this was concluded, the Lieut.-Governor of the Academy, advancing for the purpose, read to the Duke his own Report of the conduct of all the cadets, of their progress in the several classes, and of the consequent award of the different prizes.

On the first name of the recipients of these prizes being called out, a highly intelligent-looking cadet, stepping to the front, halted before the Duke, who, after bestowing upon him a well-earned and well-expressed short compliment, presented him with the sword of honour, for which, in return, the recipient—evidently, from the crown

of his head to the soles of his feet, one solid lump of happiness—gave to the Field-Marshal a salute, in strict, stiff, military form.

When all the prizes had been thus distributed, the Duke, rising, addressed to the whole of the cadets assembled a short speech, or rather a paternal admonition, in which—after with great dignity and facility having expressed to them his determination to enforce in the Royal Military Academy, as the foundation of military education, strict discipline and obedience—he pointed out, especially to those who were about to attain commissions, the career which it was alike their duty and their interest to pursue.

On the conclusion of this sensible address, which was listened to with great attention, he proceeded to inspect the dinners and kitchen establishments, and tasted,* or, at all events, appeared to taste, the beer.

In one of the halls of study, the drawings, surveys, and fortification plates by all the cadets, as well as the photographs of those who had practised that art voluntarily, were—in a few instances minutely—inspected by the Duke.

* At a critical moment, when the "*grande armée*" of Napoleon I. were on half rations, with thin claret as sour as vinegar, a soldier, advancing from the front rank of the old "garde," with a mug containing about half a pint of the unpopular mixture, asked him to "*taste it.*" The Emperor, as he sat on his horse, raised it to his lips—swigged it all off—and then, without the movement of a tell-tale muscle in his countenance, calmly said, as he handed back the empty mug to the veteran, "*Non, ce n'est pas bon.*"

The most important moment, however, of the ceremony of the day, especially to those interested in it, was the announcement of the names of the cadets who, by dint of hard study, were to receive commissions, either in the Artillery or Engineers.

On this point it should be clearly explained and understood, that, during the course of the education of the cadets at the Royal Military Academy, not the slightest distinction, or difference, is made between those who may desire, eventually, to enter the one service, or the other.

The election, or choice (for, as above stated, there is no *se*lection), is left entirely to themselves. But as those who, at the final examination, find themselves at the top of the list, are entitled to the first choice, it, practically speaking, almost invariably happens, that they apply for, and therefore receive, the vacant commissions in the Engineers.

The remainder pass into the Royal Regiment of British Artillery, which, by the science, application, zeal, abilities, and prowess of its officers, continues to be admired, respected, and in many instances copied, by its enemies as well as by its allies.

As soon as the series of important ceremonies, or rather duties, above imperfectly described, were concluded, the Duke, receiving the bow, inclination, or salute, as the case might be, of those who had attended him, entered his carriage, and at a rapid pace returned to London.

His departure, of course, produced upon the whole of the cadets exactly the effect which, upon a regiment standing motionless and quiet, under discipline, is produced by the simple word of command "*break off*," to which, in the present instance, although not expressed, was clearly enough understood, the additional words, "*and all be off to your homes.*"

The dissolving views which instantaneously commenced were composed in unequal proportions, of cadets, portmanteaus, carpet bags, and hat-boxes, sometimes separately, and sometimes conjointly, hurrying about in all directions. However, the fine, healthy brood of young birds were soon ready to depart, and accordingly,

> "With hearts beating light as the plumage that grew
> On their merry-thought bosoms, away they all flew."

PART II.

THE ROYAL ENGINEER ESTABLISHMENT.

"The child whom many fathers share,
Has seldom known a father's care."

In all countries suffering under the despotic government of an individual, a large and efficient army is usually maintained. In the constitutional government of England, thriving under a sovereign and two enlightened and well-educated houses of parliament—composed of 1122 members, each governed by a particular free will of his own—a small, costly, and *in*efficient army is always maintained. For instance—

"Nothing but abundance of money," wrote Sir John Moore, in his despatches to Lord Castlereagh, dated Lisbon, 18th and 24th November, 1808, "will compensate for the want of experience and ability in our commissariat."

And accordingly, on his retreat to Corunna, "abundance of money" was *abandoned*, and merely for want of shoes many cavalry horses were shot, many foot-sore soldiers left in the rear.

Again, when the French army besieged Badajoz in 1811, although *their* despotic Emperor had liberally supplied it with 100 miners, 483 sappers, and 60 artificers, all of whom acted as assistants, it required 41 days of open trenches to

take the place. Whereas, per contra, under the constitutional government of England, the recapture of Olivança in April, 1811; the attack of Fort Christoval in May, 1811; the siege of Badajoz in May and June, 1811; the siege of Ciudad Rodrigo in 1812; the siege of Badajoz in March and April, 1812; the escalade and capture of the French works at Almaraz in May, 1812; the reduction of the French posts at Salamanca in June, 1812; the capture of the Retiro at Madrid in August, and the siege of Burgos in September and October, 1812, were one and all undertaken and conducted by a British army unattended by a single sapper or miner (at Olivança there were present two military *artificers* — one a carpenter, the other a mason); the inadequate number of Engineer officers being supplied by infantry officers, who, in lieu of sappers and miners, selected from 100 to 200 private soldiers, who, although they literally had never seen a military gabion, fascine, sap, or mine, were collected to superintend, under fire, by night as well as by day, in darkness and in all weathers, the formation of trenches, parapets, and batteries, constructed by working parties of their fellow-soldiers, amounting to from 1000 to 2000 men.

"We have the greatest difficulty," wrote Colonel (now Field-Marshal) Burgoyne, the director of five of the sieges, "in preventing the men of the line from burying themselves."

In the year 1809 the Royal Engineer force in Portugal consisted of 16 officers and a detachment of 29 "Royal Military artificers," composed of 6 non-commissioned officers, 7 carpenters, 5 masons, 4 smiths, 1 wheelwright, 1 collar-maker, 4 miners, and 1 labourer, all alike innocent of any knowledge of field duties, and without the requisite tools and implements.

To remedy this constitutional evil, Lord Wellington, with considerable difficulty, succeeded in obtaining a larger number of Engineer officers. Previous, however, to their arrival from England, he himself framed instructions for the creation of an equipment of entrenching tools, to be carried on 100 mules to accompany the army. He also established a siege park to contain the Engineer resources, tools, implements, &c., requisite for a siege.

Yet with these inadequate means the loss of money and men at the sieges continuing to be enormous, on the 11th February, 1812, he wrote to Lord Liverpool as follows :—

"While on the subject of the artillery I would beg to suggest to your Lordship the expediency of adding to the Engineer's establishment a corps of sappers and miners. It is inconceivable with what disadvantage we undertake anything like a siege for want of assistance of that description.

"There is no French *corps d'armée* which has not a battalion of sappers and a company of miners. But we are obliged to depend for assistance of this description

upon the regiments of the line; and although the men are brave and willing, they want the knowledge and training which are necessary. Many casualties among them consequently occur, and much valuable time is lost at the most critical period of the siege."

Two months afterwards, at the second siege of Badajoz,—his irreparable loss from the inadequate means he had reported having amounted to 4822 officers and men killed or wounded),—

The fire began to burn the stick,
The stick began to beat the pig;

and the constitutional government of Great Britain and Ireland, Guernsey, Jersey, Alderney, Sark, and Man, driven by the above letter, and by the ghastly list of killed and wounded which followed it, to jump *at last* over the stile, a royal warrant was issued, under date of the 23rd April, 1812, for the formation of "an establishment for instructing the corps of Royal Engineers in *military field-works*."

Lord Mulgrave, the Master-General of the Ordnance, selected Chatham, with its adjoining dockyard and fortifications, as the most suitable place for carrying into effect the above royal order, and, suiting his action to the word, he appointed as the director of the establishment Major C. W. Pasley, R.E.; and on the 4th of the following August Lord Mulgrave further ordered "that upon the corps of 'military artificers' should be conferred the additional title of 'Royal Sappers and Miners.'"*

* 'History of the Royal Sappers and Miners,' vol. i. p. 189. 'By T. W. J. Conolly, Quartermaster of the Royal Engineers.'

But the reader may possibly interrupt me by exclaiming, "Why, how many educations are you going to give to your 'Royal Engineer'? He has had *two* already."

Now, to obtain for the reader, as accurately as possible, the information above desired, I ventured on the 22nd September last to address a circular to the head masters of all our public schools, as also to the Lieut.-Governor of the Royal Military Academy at Woolwich, all of whom most obligingly replied to the following *Question*:—"What is the average age of the twelve oldest boys at —— school?"

Their *Answers*, arranged alphabetically, were as follows:—

	Years.	Months.
Charterhouse	17	$10\frac{1}{2}$
Eton	18	
Harrow	18	$6\frac{2}{3}$
Marlborough	18	3
Rugby	18	6
Westminster	17	11
Winchester	17	6
Total	126	$7\frac{1}{6}$
Average ..	18	1
Royal Military Academy at Woolwich,—average age	20	9

Now, considering that under the latter military system, education is *compulsory*, while partly at our public schools, and almost wholly at our universities, it is *voluntary*, may it not truly be said that,

when a young man $20\frac{3}{4}$ years of age leaves the Royal Military Academy, he has practically received quite as many days' instruction as on an average have been received by young men on leaving their schools and universities? And, if so, is not the education which a young officer of Engineers *commences* at Brompton Barracks, *bonâ fide,* a third one in addition to those which end the education of our upper classes at our universities?

Having endeavoured to explain the parentage and birth of the Royal Engineer establishment at Chatham,—which, be it always proclaimed and remembered, owes its present character to the abilities and untiring energy of the late General Sir Charles Pasley,—I must now proceed to the heavy task of attempting to describe its education, or rather the education which it has imparted, and, for the general use of the army, is now imparting, to the corps of Royal Engineers, which, as by law established, for the present financial year, is composed of—

OFFICERS.

For Imperial services	384
For Indian services	336
Total	720

SAPPERS.

Non-commissioned officers and men (in 40 companies)	3838
A and B mounted troops	474
Total	4312

ROYAL ENGINEER TRAIN.

(Pontoon Troop A.)

CAPTAIN MICKLEM, R.E.

On the morning after my arrival at Chatham, immediately after breakfast, seated alongside of General Simmons on the box of his waggonette, we passed rapidly across the barrack-parade, over a drawbridge, on either side of which it appeared to me that we were separated from sudden death and destruction only by a chain. However, as one eye of our fiery high-stepping steed had reason to be exactly as much terrified at the chasm on its right, as the other eye by precisely the same chasm or ditch on its left, having no more disposition to turn to the one side than to the other, he philosophically, like a certain animal between two bundles of hay, proceeded as straightly and as cheerily as if there had been no chasm at all.

Descending the precipitous hill into Chatham, we glided through its tortuous narrow street, until, on beginning to ascend that of St. Margaret's, I caught a glimpse of Rochester Castle, and its Cathedral, in the vicinity of which I had passed my boyhood.

The old venerable square castle, guarded by a sentinel-tower at each angle, looked not a day older than it did sixty years ago. In fact, the holes in its imperishable mass of solid masonry,

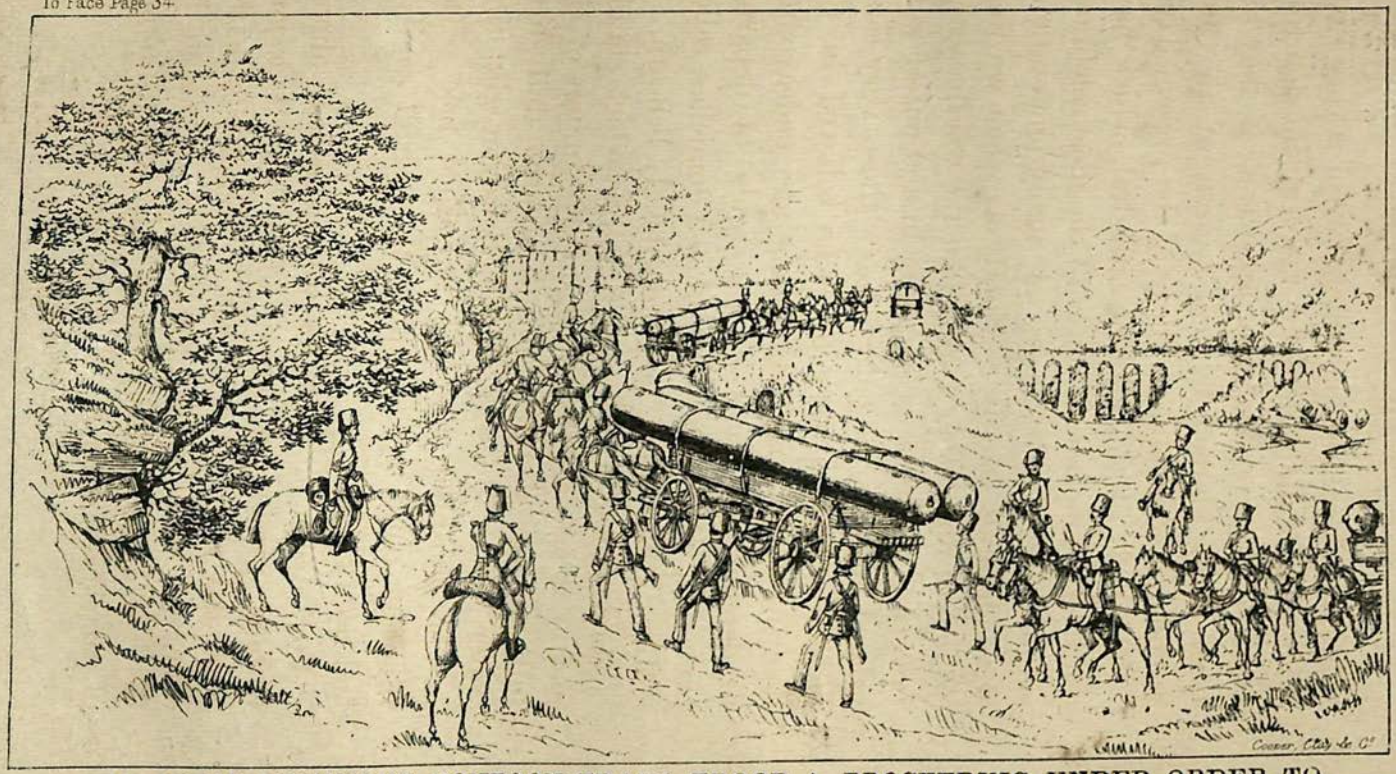
originally made for the admission of a very small allowance of light, and for the transmission from bows of tiny arrows, now appear as if they had been lately pierced by half-a-dozen of the 300-pounders and smaller artillery of the present day.

The bells of the ancient cathedral, which have outlived the melodious voices of the most celebrated singers, male and female, of many generations, were chiming exactly as clearly as when we were younger; and either perched on the weather-cock, hovering above it, or popping in and out of antiquated holes in the belfry, I saw those very same jack-daws, which some one who believed in the doctrine of transmigration long ago endeavoured to demonstrate must be the souls of departed prebends, whose low old-fashioned domiciles, called "Minor Canon Row," are immediately beneath.

On reaching St. Margaret's church, which stands, just as it has always stood, on the summit of the hill, we saw flowing beneath us the dull dirty water of the Medway, which, however, glittering in the sunshine, like the unwashed face of an innocent child, looked quite as cheerful as if it had been clean.

For about three miles we proceeded, almost without passing a house, along the Aylesford road, and were what is called "completely in the country," and, as the following day was to be the 1st of September, I was naturally thinking of partridges, when,

"Arma virumque cano!"



THE ROYAL ENGINEER PONTOON TRAIN, TROOP A, PROCEEDING UNDER ORDER TO BRIDGE A RIVER.

London. John Murray. Albemarle Street.

all of a sudden I saw immediately on our right, in a green meadow which sloped downwards to the river, the white tents of a military encampment, in front of which there appeared drawn up, and drawn out, a heterogeneous line of scarlet Sappers under arms, horses under men, and waggons under a blue strange-looking load, forming altogether "The Royal Engineer Pontoon Train," in front of which, seated on his horse, with drawn sword, and in full uniform, sat, as upright and motionless as his men, its commander, Captain Micklem, R.E.; and in this position I must beg his permission to leave him for a very few moments, very briefly to observe that a pontoon train, which by all military authorities has been considered to be a necessary accompaniment of every manœuvring army in the field, for its passage, without delay, over rivers, canals, or other inland waters, where there are no standing bridges available, is usually either distributed among its divisions, or kept in advance, or in rear, or in reserve, or otherwise, according to the anticipated requirements for it.

A pontoon equipment should combine in the greatest possible degree—

1. Thorough efficiency as a floating power when used either in parts, or put together.

2. To be light and compact on its carriages for transport, and to be easily and rapidly put together or dismantled.

3. Simplicity in construction, so that any part that may be defective or deficient can be readily replaced.

4. Durability and strength to bear rough hard usage.

Several different systems for a pontoon equipment have been adopted in different countries; and it is therefore still a matter for military study as to which of them is best in whole, or in part, or what improvements or substitutes can be suggested for all.

Pontoons, of ordinary shape, are not exclusively applicable for forming a *bridge*; when insufficient for that object, they may be used as boats or in rafts to convey bodies of troops across a river; the horses being made to swim with their heads held up by their bridles at the sides of each pontoon—the artillery in such cases being carried over on rafts;—indeed, it was in this way that, in 1814, a preliminary footing was rapidly established on the right bank of the Adour, about three miles below Bayonne, capable of resisting the strong sortie sent out from that garrison to oppose it.

Of numerous similar instances of the service which even an extemporised pontoon-train has rendered to an army, I will select only the following one, recorded by Captain Conolly in his 'History of the Royal Sappers and Miners,' vol. i. p. 254 :—

"A reinforcement of thirty men, under Lieutenant Rutherford, R.E., arrived at the Cape of Good Hope on

the 24th July, 1819. In consequence of hostilities with the Kaffirs, the detachment marched 700 miles to the south-eastern frontier. It traversed a wild and thickly-wooded country, where there were neither bridges nor roads; and in the absence of soldiers of the Quartermaster-General's Department, facilitated by their exertions the progress of the troops. In places where civil artificers could not be procured at any rate of wages, they executed various services and works of defence for the security and tranquillity of the settlement. On one occasion they constructed a temporary bridge, of chance materials, to span one of the principal rivers of the country, which was swollen by floods, and rendered deep, rapid, and dangerous. The bridge was thrown in six hours, and the whole of the force, about 2000 horse and foot, a demi-battery of guns with ammunition-waggons, about 100 baggage-waggons with commissariat supplies, camp equipage, &c., crossed in perfect safety in three hours."

Until the year 1862 the Royal Engineers' pontooning ground for the corps had been close and convenient to their barracks; but on the absorption of this ground for the purpose of extending the Dockyard at Chatham, it became necessary to remove it elsewhere, and, accordingly, the present locality was selected, for the double object—

1st. Of securing a position in which all Engineer officers and sappers could be instructed by practice in throwing pontoon bridges from bank to bank; and—

2ndly, During this course of instruction, by encamping officers and men, and by picketing their horses, to educate and habituate all, in some degree,

to camp life; so that, when suddenly called into active service, they might not find it strange to them. By such means the soldier, in peace, is best prepared for his duties in war; and, as it takes fourteen months' instruction in the Royal Engineer establishment to convert a recruit into a sapper, a change from barracks and a barrack square to canvas, turf, pure fresh air, and muddy water constitutes a recreation as wholesome for his body as for his mind. For the above reasons it has been wisely resolved not to erect any permanent buildings for either men, waggons, &c., during the instruction of the former, but to send all the requisite materials from Chatham at the commencement of each season, parking them during the summer.

The practising ground lately purchased by Government for this object contains about 20 acres of meadow for encamping, with about 7 acres on the opposite side of the river, so that eventually, as the roads leading to both are improved, bridges may be thrown across from bank to bank, to be practically tested by troops and guns passing over them.

The soft banks on both sides of the Medway between high and low water marks have been covered by the sappers with two rows of fascines, upon which they deposited a thin stratum of chalk, with a coat of gravel on the top, to enable them to work at all times of the tide without sinking above

their knees into soft mud. Medway mud, however, like Napoleon's "clouds of Cossacks," is a troublesome enemy to subdue, for such quantities of it—stolen by the rain from the estates, not only of neighbouring, but of far-distant landed proprietors—are carried off in suspension in the water, that it speedily settles, or, as emigrants term it, "locates," forming a slimy covering to whatever it rests on.

This inconvenience, especially during the prevalence of certain winds, must always be experienced at the point selected; however, the Engineers neither made the river nor stole the mud, which, after all, is not a bad instructor to those young officers and sappers who have to learn pontooning for actual service.

The Royal Engineer Pontoon Train, in peace, consists of one troop of the following strength:—

1 captain
3 subalterns } *Royal Engineers;*
122 N. C. O. and sappers;
140 horses;
95 drivers;*—

and drawn up in the form above described for General Simmons's inspection, it certainly formed a picture of discipline and organisation which I did not expect to witness.

The whole detachment, composed of drivers and

* Whenever necessary, the sappers assist the drivers in cleaning both their horses and their harness.

sappers, were, as regarded their upright, military, and physical appearance, their uniforms, their accoutrements, their horses, and the state of their harness, in as high order as those respectively of a regiment of the line, cavalry, or artillery, while encamped; and as the drivers, during the time General Simmons was minutely inspecting the whole train, sat motionless on their horses, each with an extended whip in his right hand, the lash resting on the shoulder of the off horse, the waggons guarded by 65 non-commissioned officers and sappers armed with Sneider artillery carbine rifles, I could not help contrasting the whole with my recollection of the pontoon train attached to the Duke of Wellington's allied army in France in 1815.

The troop, composed of 12 waggons, weighing 46 cwt. 20 lbs. (each carrying two blue pontoons, with all necessary superstructure, and drawn by six horses), is divided for discipline, and if necessary for detachment, into three sections, each under an officer of Engineers. The whole can form 100 yards of bridging fit for infantry, marching at open order, four in front, or for cavalry or horse artillery. If required for field-guns, in order to strengthen the bridge the 100 yards must be contracted to 80.

Every driver, as well as every non-commissioned officer of sappers and drivers, has for his saddle, instead of hempen girths, a South-American raw-

hide surcingle, to which he is drilled to attach a lasso, to be used by him whenever required.

Each driver's off horse carries his kit, packed in a valise covered with black sheepskin, a tin canteen for cooking or carrying food, a wooden water-bottle, nose-bag, forage-rope, and cleaning implements. The traces of the leading horses, I observed, are cleverly divided into two lengths, connected by hooks, which, on being uncoupled, enable these leaders at once to act as wheelers; and, as all the horses' eyes are emancipated from "blinkers," they see and understand as well as the drivers the nature of the work their country requires them to perform.

To each section is attached—

One general-service covered waggon, weighing $26\frac{3}{4}$ cwt., drawn by four horses, carrying two spare drivers, and containing camp equipage, *i.e.* tents, blankets, and water-proof sheets for the men, horse-clothing, intrenching tools, axes, bill-hooks, &c.

The whole train is also accompanied by a similar covered waggon, laden with tools for carpenters, wheelwrights, tin-smiths, painters, collar-makers, and blacksmiths.

One forge waggon complete (4 horses), weight $36\frac{1}{2}$ cwt.

One waggon (6 horses), carrying an iron boat, 21 feet long, $\frac{1}{16}$ of an inch thick, for casting anchors and laying out moorings: weight $33\frac{3}{4}$ cwt., and capable of holding ten men.

One spare waggon (4 horses), containing a landing-bay, spare wheels, cables, oars, and axles: weight 46 cwt.

One cart (2 horses), fitted up as a travelling office, containing the books and papers of the troop, a complete case of surveying as well as of drawing instruments of different descriptions, &c.: total weight 13 cwt.

To each pontoon-waggon is attached as its guard, and to assist in forming the bridge whenever required, one non-commissioned officer and six sappers, each armed with the short "artillery carbine" breech-loading rifle.

The weight of each pontoon-waggon, loaded for the march, is 46 cwt. 20 lbs.

To the whole troop are attached only four spare horses—a meagre allowance—which, on actual service, would of course be insufficient.

I was greatly pleased with the shape, make, style, and breeding of the horses attached to the train. Stout, short-legged, short-backed, punchy, and yet very active, they appeared admirably adapted to the varied work they have to perform.

The credit, however, of their selection belongs, not to the Engineers, but entirely to the officer of artillery, whose duty it is to supply the troop with horses similar to those which have always distinguished his own service, which appears to be gifted with an hereditary talent for obtaining active valuable draft horses of unusual description.

In addition to the waggons, horses, and men above described, there were attached to the encampment—solely for instruction in pontoon exercise—8 young engineer officers and 84 sappers, all of whom I observed hard at work learning to throw across the river beneath us, 160 yards broad, a pontoon bridge, on which some were standing, and many kneeling.

As soon as the Pontoon Train, with its covered waggons of supplies, &c., guarded by its band of armed sappers, had, after a minute inspection, what is technically called marched past, in stiff military order, the six horses of one of the carriages carrying two pontoons were, in compliance with my request, detached from it, and in their stead six non-commissioned officers in full uniform, with their swords in steel scabbards dangling at their horses' sides, were ordered, with lassos * unhooked from their own saddles, to replace them. The mandate was promptly obeyed, and the waggon to be drawn by six non-commissioned officers' horses in front, and with two with lassos attached to it behind, for the purpose of holding it in going down hill, was on the point of advancing, when, observing that the youngest trumpeter of the train was the only remaining useless horseman, I said to General Simmons, "Can't *he* help too?"

Without answering me, he at once gave my sug-

* These "lassos" are simply strong 1½-inch ropes of different lengths, fitted at one end with a tug-hook, and at the other with clip-hooks.

gested order to the lad, whose saddle, like those of the non-commissioned officers, having been equipped with the South American raw-hide surcingle and lasso, and he having also like them been taught the application of the latter, he at once hooked on to the waggon, and, at the word of command, the six non-commissioned officers and their trumpeter walked away over turf (a much heavier draft than a hard road) with 46 cwt., leaving behind them a moral for the consideration of cavalry of infinitely greater weight and value.

As soon as this experiment was concluded, and the drivers had reattached themselves to their waggon, the whole train was ordered to advance in file—that is, one pontoon carriage, &c., guarded by its sappers, following another. After they had proceeded in this shape for a short distance, Captain Micklem very sharply uttered the word of command —"*Form for defence against cavalry!*" and in less than two minutes, by a movement exactly the reverse of that described by the lines,—

> "These are Clan-Alpine's warriors true;
> And, Saxon,—I am Roderick Dhu!"—

he, his horses, his drivers, and his sappers, became the invisible garrison of a fort or polygon of twenty sides, formed by his pontoon and covered waggons drawn up so close to each other that in several instances they almost touched, and in others left an interstice or embrazure of about a foot or 18 inches on the outside.

As I rode round and close to this rapidly constructed fort, whenever I came to an interstice, a sapper on one knee, with his sword in bayonet-form attached to his firearm, with two others standing one behind the other above him, each and all looking direct at me, nearly together snapped their Sneiders in my face. Others beneath the waggons shot at me from between the wheels; and I have no hesitation in saying that the officer's word of command was so completely carried into practical effect that the rampart formed by his waggons was totally impenetrable, not only to cavalry using swords, but to lancers.

Now, without intruding upon the reader any valueless opinion of my own on the importance of the above Engineer's manœuvre, I will simply contrast it with the following extract from Captain Conolly's 'History,' describing the Pontoon Train under the Duke of Wellington in 1815 (a portion of which, on its march to Paris, as already alluded to, I had what is commonly called "the *honour* to command" :—

"On one occasion, near St. Denis, all the sappers of the army, nearly 1000 strong, were assembled to witness an execution, and, strange to add, in that imposing force there was not a single fire-arm!

"At another time there was an inspection of the Pontoon Train of eighty pontoons and other carriages, with horses, drivers, and pontooners, occupying a line of road nearly two miles in length. The sappers were present in their whole strength, but without a musket in their

ranks to show the quality of protection they could afford to the immense charge intrusted to them. Fifty men with fire-arms could easily have destroyed the whole force in ten minutes."

This striking contrast will, I humbly hope, help to demonstrate to the public the miserable results of the English firmly-established system (Portugal, Spain, Belgium, France, and the Crimea to wit) of maintaining at enormous cost an army of brave *men*, who, from parsimony and mistaken economy, are hurriedly despatched to a battle-field, destitute as beggars of the ordinary requirements of war.

As the chief danger which the baggage train of an army has to apprehend is the dash of a bold and enterprising cavalry, I submit that the principle of self-fortification, as above developed, should not, as it hitherto has been, be allowed to remain perfectly disregarded by our army authorities.

But to return from this discussion to the men and horses which it left enclosed by 20 waggons, within a circle not exceeding 60 yards in diameter.

The mode in which the officer's word of command, "Form for defence against cavalry" (which the sappers and drivers among themselves, from its circular shape, and from the Sneider sparks that centrifugally fly from it, travestie into "*Form Catherine Wheel!*"), is in detail effected as follows:—

At the word of command, already quoted, the leading waggon, after curving, at first slightly and

then strongly to the left, halts; the succeeding waggon, curving in like manner to the left, is made to halt so that its side may touch or nearly touch that of waggon No. 1; and exactly the same curved operation is performed by the remaining waggons, until, by the right side of waggon No. 20 being made to touch or nearly to touch the left side of waggon No. 1, the whole of which with tired horses, I was informed, can be done at a trot, the magic circle of defence is completed.

The state of the garrison, however, is extraordinary, and at first sight appears very alarming, for, excepting a very small clear space in the centre, the horses are jammed together so closely that most people would expect that, in this state, there would break out among them a civil war as fearful as the attack, real or imaginary, they were formed to resist.

However, this is not the case. In hunting in Leicestershire it is a daily and occasionally almost an hourly occurrence, that, say 150 scarlet-coated men on horses of high breeding, in order to avoid an impracticable fence, converge at a gallop upon a gateway, in the approach to which for several minutes they are jammed together so tightly that occasionally the mass cannot advance an inch; and although, during this time, and subjected to this squeezing, there are among it many well-known and well-avoided "*kickers*," yet the bodies, and bones, and legs of the animals during the opera-

tion are so hustled, that the vicious for the moment only—greatly against their wills—become virtuous.

As I sat on my horse outside the fort, peeping through its waggon-embrazures at its garrison of compressed centaurs, I certainly felt that I should prefer trying "to get 20,000 men out of Hyde Park," to attempting to undo the engineering puzzle before me. However, impracticable as it appeared to me, I saw it very easily effected by the simple word of command—"*Disengage!*" On which the drivers of pontoon No. 20, advancing with their six horses, not *out* of the fort, but *into* the small vacant space in its centre, simply halted; and a gap having thus been made, pontoon No. 1, wheeling its six horses to the "right about," moved through it straight away from the circle, followed in like manner by the rest of the troop, "in columns of subdivisions," or, as Messrs. Pickford and Co. would more mildly term it, "single waggons," ready for any formation they might be required to make.

In getting in and out of this Catherine wheel, I observed such horsemanship on the part of the drivers, that I own I was unable to understand how in mere pontoon-train service it could possibly have been acquired.

On inquiry, however, the mystery was clearly enough explained to me.

It appears that, when the services of the men

and horses of the Royal Engineer Train are not required for pontooning, they are utilized by their officers in drawing stores, &c., for engineering purposes.

For instance, *at Chatham* their "fatigue-duty" has been to transport materials for field-work experiments, &c.

At Aldershot two-thirds of the Pontoon Train horses have turned out every day to cart materials for the public works which Engineer officers are executing there, such as building barracks, &c.

Under Colonel Simmons, R.E., they assisted not only to make the dam of the principal reservoir that supplies the camp and barracks with water, but they hauled away, across rough and occasionally miry roads, a very large portion of Hungry Hill (many thousand loads of gravel), to make the parades and roads about the camp.

At this labour the Royal Engineer Train, I was informed, has under its own officers, worked for six or seven years (some of them are at it now), not only creating thereby skilful drivers and serviceable manageable horses, but effecting a large saving to the public.

In fact, I believe it may truly be said, that every pair of Royal Engineer horses at the above work have paid, and are paying, for their own keep, and for their drivers' daily pay, which averages (there are different rates) 1*s.* 7*d.*

Now, instead, I will not say of applauding, but

simply of encouraging the Royal Engineer Pontoon Train in the zealous performance of the heavy work above detailed, the very same fatal principle of parsimony and false economy which has neglected to prepare for the army what it wanted, has been deliberating, and by many advocates is still advised, in time of peace, to destroy an important portion of what it has got, by transferring the drivers and horses of the Royal Engineer Pontoon Train A with those of its mounted Train B (whose duty, as will hereafter be described, is to carry entrenching tools, &c., for the defence of the army), to "a General Service Train," which it is theoretically stated *should*, but which in practice never *would*, provide for such periods as may be required experienced draught horses *for all services of the army*, except the Artillery.

The project of converting these two efficient trains into what is mildly termed "a General Service Train," rests on the argument that draught horses and drivers are, and therefore ought to be, equally efficient for any description of work. The argument equally applies to the soldiers of the Guards or line, who, because they proved their courage, strength, and endurance at Alma and Inkerman, might *therefore* be economically set to work in time of peace as "general service labourers" on any and every description of public work.

For bringing up siege trains, or great pontoon equipments held in reserve for very occasional

operations, the Royal Engineer Troops A and B might reasonably be required to, and no doubt would, for a short period, zealously assist; but the economical project under consideration, of breaking up both if deliberately established, would, I firmly believe, fail in profit, and end in ignominious loss.

In forming a pontoon bridge 60 sappers are employed, with which number the unpacking of the waggons, the descent of the pontoons, and the formation of the bridge (every act of which, as well as every subsequent movement in breaking it up, is given by word of command), can be carried on simultaneously.

The bridge, when constructed, is about 10 feet wide, and, when intended for horse artillery, is formed with the pontoons moored at intervals of 12 ft. 6 in. When heavier loads are required to be passed over it, these intervals are contracted to 10 or 8 feet, but, excepting on a raft consisting of three pontoons, no heavier gun than a 20-pounder should be taken across the present construction of pontoon. Sixty sappers can form 100 yards of this bridge (at full intervals of 12 ft. 6 in.) in about 40 minutes, including unpacking the waggons.

In 1815 the Pontoon attached to the British army was a long, narrow, flat-bottomed, iron, open boat with hollow sides. In the year 1825, after a trial at Chatham on the 26th of September, in presence of the Duke of Wellington, of the capabilities of several descriptions of pontoons, this

unwieldy boat (which, in spite of its defects, had in July 1815 formed a bridge across the Seine, over which first passed the Duke of Wellington, and then the whole army, with its artillery and baggage) was superseded by one invented by the late Major Blanchard, R.E., which in shape is simply a hollow tube of tin, 22 ft. 3 in. long, with hemispherical ends, which enables it, when moored in a tidal river, to present to both ebb and flow a sharp-pointed prow.

The interior of this pontoon (2 ft. 8 in. diameter) is divided into nine water-tight compartments, each separated by a wheel with spokes, which, being backed with tin, thus making each compartment water-tight, enables it to be easily pumped dry in case of leakage.

Its advantages have been, and are, that, being tubular, like a corked empty glass bottle thrown into the Atlantic, it cannot possibly be swamped.

The defects, however, of this long-tried faithful servant are now declared to be—

1st. That it is weak in its back, *i.e.*, it has not floatation to carry a heavier gun than a 20-pounder; and being moreover liable to be submerged by a moderate crowd of men, it is no longer able to bear those heavy burdens which modern war now unmercifully imposes upon a pontoon.

2nd. Its waggons, when loaded, are too heavy. A waggon laden with two, being equal in weight (46 cwt.) to a 20-pounder gun, in crossing a diffi-

cult country could not be made to keep up with the lighter horse or field artillery, for the passage of which over a river they were required.

3rd. On a march its weight precludes the sappers from being carried on its waggon. Its tubular form prevents it from being used as a boat.

General Simmons therefore for a considerable time has been making a series of experiments with a new pontoon, which he calculates will possess the following advantages:—

1st. Its greater buoyancy will enable the new bridge to carry a 40-pounder gun of position, and by very slightly strengthening the roadway, a 64-pounder can be taken across it.

In this new equipment, each waggon laden with one bay or 15 ft. of bridge, will weigh from 35 to 36 cwt., which, being about the same as that of a 9-pounder Royal Horse Artillery gun, the Pontoon Train, thanks to the Artillery, gifted with equally good horses, will, on emergencies, be able to keep pace on the line of march with the noble weapon it is intended to convey across water.

As the proposed improvement is one of great military importance, I was glad to be able minutely to inspect it.

This new pontoon, which I found lying near the river, was constructed (from a design prepared by a Committee of Engineers, and approved of by General Simmons) by Mr. Clarkson, of

his valuable material, consisting of a casing five-eighths of an inch thick, composed two-thirds of a layer of cork, and one-third of pine-wood, connected together by thin canvas, saturated with his water-proof composition; a thick coating of a different composition protecting also the outside.

The sides of this new pontoon, including its decked ends, have a double casing, with an intervening air-space, which gives buoyancy, and which, from being divided into separate compartments, cannot by a shot or other accident be sunk. To my surprise, its bottom is perforated by a hole about $1\frac{1}{2}$ inch in diameter, which allows a pipe to pass from the upper flooring through the air-tight chamber to the water below. And, as the pontoon when laden with the whole of its own superstructure, and a light moving load, equal, say, to a horse or eight or ten men, does not draw sufficient water to immerse it to the depth of this upper floor, not only will no water rise *into* the pontoon, but any water that has got into the pontoon will flow *out*.

Not satisfied with the result of a series of experiments which demonstrated that a pontoon of Clarkson's material, of the dimensions given to it, possessed the necessary amount of floatation, it was resolved to subject the interior as well as exterior of this valuable public servant to the amenities of martial law, truly designated by the Duke of Wel-

lington as "no law at all." By the sentence therefore of a sort of drum-head court-martial, of which General Simmons was president, it was subjected to almost every description of mal-treatment.

First it was shot at; then holes were knocked, or rather attempted to be knocked, into its sides with sledge-hammers; then its unoffending bottom was dragged over rough, uneven, stony ground.

In its wounded state it was heavily laden, and in that condition men in unbroken step were marched over it, and yet in frame and spirits it continued adequately buoyant.

The efficiency of Clarkson's material having been thus proved,—

> "So they boil'd Bill Jones in the negro pot,
> To see what fat he had got,"—

the sappers and artificers of the pontoon train, under the direction of one of their own officers, are now employed in making with it a complete equipment to suit the full requirements of modern war.

Three pontoons on the same principle, and of the same material, but all three differing from each other in various details, have been experimentally made under General Simmons's supervision, in order to ascertain the best details to be finally adopted.

For this object a new description of baulks, not requiring to be pinned in, experimentally constructed of American elm, of Kaurie pine, and of Honduras mahogany, have, on a single section of roadway, been subjected to rude and severe trials.

Sappers packed upon them in fours, as close as they could stand, were made to mark time (the severest practical test that can be applied). The result showed that the elm baulks stood the best. Under a similar severe test, one of two boats, expressly made as light as possible for facility of transport, showed that it required a little strengthening in its floor. The other proved to be efficient.

Subsequently I witnessed in the barrack-square at Brompton still severer tests, which will be described. The result of all is that the sapper-artificers of the pontoon train under Engineer officers are now themselves constructing of Clarkson's material, and fitting up, an experimental pontoon train of 100 yards in length, with a view to its general adoption in the service.

Each of these new pontoons (of Clarkson's material), with five yards of superstructure, including ropes, anchors, oars, &c., carried complete on one waggon, will weigh only from 35 to 36 cwt. It will therefore, when drawn by six horses, be capable of being used with speed, to accompany, on a march, cavalry, or a 9-pounder Royal Horse-artillery gun,—or with four horses, infantry.

BARREL PIER BRIDGES.

(*All officers, non-commissioned officers, and sappers* of the whole corps are practised at this.) A certain

number of barrels, usually the ordinary ones used by the navy or commissariat for provisions and rum, according to their size and power of floatation, are firmly lashed together side by side, and in this form take the place of the piers of an ordinary permanent bridge, or of the pontoons of a floating bridge.

The seventy barrels I witnessed would enable an army without pontoons, with its cavalry, field-artillery, and infantry four deep, to cross a river fifty yards broad.

The wooden cases lined with metal, used for carrying on board ship ammunition for the new heavy guns, can be adapted by the pontoon train for this purpose.

Since the moment of my arrival in the camp, and during the whole time I was witnessing the series of experiments I have endeavoured to describe, the eight young Engineer officers and eighty-four sappers under tuition were busily occupied in throwing a portion of a bridge across the Medway, and accordingly, dismounting from my horse to pass over the stratum of fascines, &c., lying on mud, through which the animal would have sunk, we walked down to witness the operation, every detail of which was directed by the word of command, through a speaking-trumpet, of an old veteran moored in a small boat, who—although he rather closely resembled Virgil's description of the head of Neptune rising out of troubled water—was in reality

Serjeant-Major Knight, Field-work Instructor, formerly a serjeant in the trenches before Sebastopol.

As fast as two of the blue pontoons were with considerable ingenuity removed from their waggon, and across a very slimy, slippery, dirty roadway, were launched into the water, they were secured in their position, both stem and stern, by anchors* dropped in their proper localities from a boat; and were fixed at the ordinary prescribed interval between them of 12 ft. 6 in.

The process of connecting them together was, in plain words, that which forms the flooring of a house, in which on sleepers rest joists, and on joists floor-boards.

In technical pontoon language, the sleeper or "saddle" is fixed longitudinally along the upper circumference of the cylindrical pontoon. The joists or "baulks" resting on the saddles, and "pinned" to it, connect together the two pontoons.

The floor-boards or "chesses," 2 ft. 1½ in. broad, are then laid transversely, one after another, on the baulks, and finally, for the purpose of forming a guard-rail to prevent wheels from going off the bridge, baulks, oars, and boat-hooks, laid longitudinally above the extremities of the chesses, are secured in their position by rack-lashings, which,

* The number of anchors required by a pontoon of course depends on the force of the stream or tide, and the nature of the bottom as a holding-ground.

passing round the chesses (planks), and the outside baulks (joists) below them, are tightened by a rack-stick, which finally fixes them steady as a vice.

At this interesting drill, all were, under instruction, by word of command, performing their various duties with zeal and intelligence; and utterly regardless of slime, mud, slush, or water, they were to be seen in various attitudes, and especially on their hands and knees, racking the rail-guard, which requires practised manipulation.

In the ordinary daily drill which I thus witnessed, the young Engineer officers, with a view to increase their practical knowledge, were, I observed, required to perform non-commissioned officers' duty in charge of rafts.

H.R.H. Prince Arthur (at present the junior lieutenant in the corps of Royal Engineers) belonged to the first party encamped for pontoon instruction, in which he took such zealous interest that on one occasion he was seen swimming, with his clothes on, in water the mud of which was very little calculated to improve them. But he is reported to have said on joining the Royal Engineer Establishment, "*I am not come here to shirk work*," nor did he.

On the side of the Medway, nearly opposite to the encampment, I observed a large deep chalk-pit. Some years ago its proprietor asked the Royal Engineer establishment at Brompton to assist him in working it, on the readily accepted conditions that he was to find *powder*—they *men*.

In this labour of love the Engineers, officers and men, earning experience in mining and in manipulating large charges of powder, employed themselves nearly six weeks, sinking shafts about sixty feet, driving galleries fifteen or twenty feet, and eventually effecting the object of the proprietor by explosions, in which the charges all fired simultaneously by electricity amounted to 50 barrels, each containing 100 pounds of gunpowder. Actuated by the same "*esprit de corps*" as volunteers, they afterwards effectually demolished and removed the ancient bridge of Rochester, a labour which required nearly 1000 men.

All the sappers of the whole corps of Engineers are taught to row, and as a necessary precaution to swim. As a proof of their proficiency in the former useful art, I was told that two days ago a ten-oar cutter race took place between the men of the Royal Marines and those of the Engineers, both parties having practised for two or three hours per night, for about a mile and a half up and down the Medway, the tide thus being alternately for and against them. The Engineers accidentally broke an oar at starting, but, in spite of that, beat the Marines, on their own element, by thirty seconds,—at least so their antagonists say. I write cautiously, recollecting a Scotchman's shrewd observation to a similar assertion, "*Yas! but the deevil is—ye canna* BELIEVE *'em.*"

On leaving the pontoon bridge we ascended

across the grass to the camp, which, as already stated, forms a hollow picturesque square, bounded or guarded in front by its line of blue pontoons on their carriages, the other three sides being hedged in by white tents pitched 25 feet from centre to centre. Parallel to the tents the horses I had seen at work stood picketed, thus leaving a vacant space in the centre.

The sappers' tents—15 feet in diameter—which on service would shelter 15 or 18 men (in Abyssinia they lodged 12 officers or 20 men)—here contained about 12. They were luxuriously boarded by a circular floor of wood, composed of four segments of the whole circle. In rear of the horses were other white tents for officers and stores, with cooking-sheds covered with black canvas.

During their intervals of work the pontoon-men retire to their canvas homes, to enjoy Sancho Panza's "blessing," *i. e.* sleep.

The camp, which on its formation had no water, save the saline, muddy, griping mixture of the Medway, is now abundantly supplied by two tiny American wells, composed of a slight iron tube, driven into the ground by the combined forces of two men and a monkey, and whose iron handles are barely two feet long. One of these pumps was driven by the aforesaid two sappers and a monkey, (or dropping weight of 75 lbs.), through 17 feet, chiefly of hard chalk, in about an hour and a half.

It was immediately set to work, and has yielded, I was informed, throughout all this dry summer, an abundant supply of water for 120 men and 12 horses, which, though thick just at first,* has since been and still is (I can vouch for this) beautifully clear and cool. The whole corps of sappers are instructed to drive these tubes.

As the Abyssinian army—Sir R. "Napier," (or "Noah,") and his ark of animals,—staff, army, elephants, chaplains, camels, horses, mules, donkeys, &c.,—were, as he has himself reported, abundantly supplied, or rather suckled, for certain periods, by these simple instruments, inserted and superintended by 1 officer, 1 non-commissioned officer, and 20 sappers from the Royal Engineer Establishment,—it may be proper to explain that their object is limited to obtaining water in those situations only where the water-bearing stratum is within the depth from which it could be drawn by a common suction-pump; that is, about 28½ feet.

These American tube-wells possess the following military advantages:—

1. They and the apparatus for fixing them, being simple, are not easily put out of order.

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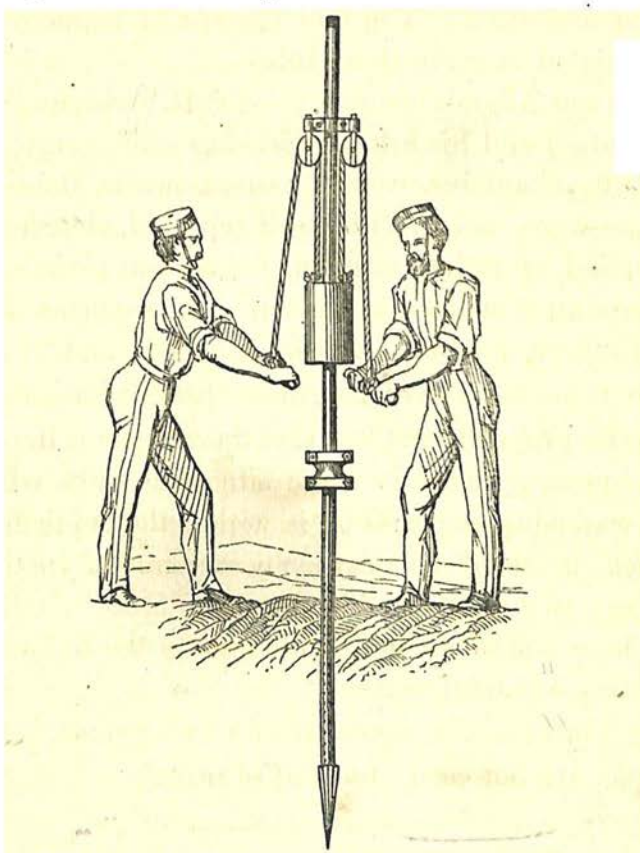
* The American who came to Chatham to exhibit these wells for experiment, after driving the pointed tube first through a stratum of earth, and then deep into the chalk, on beginning to work it, shrewdly and good-humouredly observed, with a strong nasal twang,—"Wall! this is the first time I have struck *milk* from the earth; and I guess if I could sink such a well in America I should just make my fortune!"

2. Being light and divisible, they can be carried on pack-saddles.

3. Being easily withdrawn, they can be re-used.

4. Being readily applied, they can be used for raising water not only from beneath the surface



American Tube Well.

of the ground, but from ponds or rivers for the purpose of filling troughs or reservoirs, thereby obviating the annoyance to soldiers of having to drink water made muddy by themselves, from

having been allowed to dip into it from its edge, and, moreover, made foul by horses and cattle.

The solitary agent in raising the water is a series of small iron tubes, usually about 10 feet in length (in Abyssinia, for convenience of transport on mules, they were only 6 feet), and of about $1\frac{3}{4}$ inch in diameter, the lowest of which is perforated by tiers of holes, which, terminating in a solid iron or steel point, enables it to be forced down by any simple driving apparatus (*see* sketch). The tubes, as fast as they are driven, are connected by a wrought-iron collar 2 inches long, which by means of a screw firmly or matrimonially binds them together.

Where the stratum containing water is very porous, as in gravel or some sorts of chalk, it flows healthily; in sandy loam, sluggishly; in quicksand, asthmatically; and in dense clay it expires.

The whole of the pontoon horses are picketed *—each by a strap round one of his fore fetlocks—to stout ropes or lines, 25 yards long, subdivided by strong pegs driven into the ground into lengths of 25 feet each.

The troop-serjeant-major informed me that at night, out of thirty horses, about five or six lie down at a time,—say ten or twelve throughout the night. He added (I think erroneously) that in

* All the sappers, as well as drivers of the R. E. Train, are *drilled* in camping and picketing horses.

permanent cavalry barracks, where horses in halters attached to their mangers are separated by swinging bails, he had observed that about the same number only, probably from the fear of being kicked, lie down at night.) He added, truly enough, that horses can sleep standing, and he might have added that men, especially fat ones, can go to sleep while sitting on them. At night, in fine weather, they have a thick blanket; in wet weather, a waterproof protection to their backs and loins.

I observed an ingenious mode of cooking adopted by the sappers. With a few hundred bricks, which I was informed they themselves collected from an old building, they have formed an oven 1 foot 10 inches only above the ground, a small iron pipe, hooded at top, making the chimney; while an iron door and handle, forged by them in camp, keeps the heat in, and thereby enables the oven (I was told) to cook dinners for 200 men; and if so, its adoption in encampments would be a great luxury to all soldiers (infantry as well as cavalry), whose food, generally speaking, is cooked in camp-kettles, made to *boil* in a trench. In addition to the above, I saw a field-oven for feeding the officers and non-commissioned officers, made by the hands of the sappers.

Also a slate sun-dial constructed and erected by the latter, which told me the time truthfully; and lastly, a forge with its supply waggon.

The officers' mess-room was a tent handsomely furnished with a variety of hard-bottomed benches of not exactly the same height, and with a deal table, whose shape at once declared it to be the child of parents of very irregular habits. In Euclid's 'Definitions' we learn that "all quadrilateral figures besides these (a square, a rectangle, a rhombus, or a rhomboid) are called *trapezia*." The Royal Engineers' camp mess-table at Wouldham I therefore proclaim to be a *trapezium*.

As throughout my life I have agreed with the prescription of a South American Gaucho, who, when I offered him money to get a bottle of wine in sunshine, replied, "*No, Señor! vino con sol, no es bueno!*" while the young officers were partaking of refreshment I strolled for a few minutes by myself into the camp of instruction, which imparts to engineer officers, sappers, and drivers, the following preliminary education :—

1. It teaches them zealously and cheerfully to perform work beneficial for the army, be it rough or smooth, dirty or clean.

2. It teaches the whole corps how to conduct and construct, for the passage of an army, bridges of pontoons or of casks—how to repair pontoons —how to make them.

3. It teaches them all to row and to swim; so that if on service a secret order, either verbally or in writing, be despatched by a sapper, on coming to a narrow river, he can, if he can seize a boat, row, if not, swim across it.

4. It teaches them how to live with horses in an encampment.

5. Lastly, it teaches them to make themselves, on Her Majesty's service, useful.

On returning to Brompton Barracks after the inspection I have endeavoured to describe (which occupied five hours), I entered the vestibule of its principal hall.

THE MODEL ROOM.

"Of what vast consequence is man!
Not of th' importance you suppose,
Replied a flea upon his nose."

Gay's *Fables.*

If a large landed proprietor, while looking down from an eminence upon his almost boundless estate, should feel his mind gradually becoming what old nurses call "windy," or, in the windier words of our great lexicographer, "inflated with pride," there is no medicine in the London Pharmacopœia which can produce so cooling, so chastening, and so salutary an effect, as for a friend, suddenly from behind his back, to hold before his eyes an inverted telescope, which, in one second, reduces his noble mansion with its tenements to apparently a cottage and pigsty, his broad river to a shining thread, his park to a tiny meadow, his deer and hunters grazing therein to field-mice, and the beloved members of his family and their retinue of servants to animalculæ, crawling or hopping according to their respective ages.

In like manner, in the moral world, the life of man in his own estimation teems with pompous appurtenances. There are the throne, the palace, the woolsack, the church, the state, and other prominent objects of human ambition, all of which, when suddenly viewed through approaching Death's inverted telescope, suddenly delineate nothing clearly, save

the outlines of a very small cradle and a very narrow grave (illuminated by the prismatic colours of a rainbow, or shadowed by a dark cloud), separated from each other by a mist which renders everything between them invisible.

But a "*model*" is the image of an object seen through an inverted telescope, the focus of which has been scientifically adjusted, so as to reduce dimensions without rendering any one of their component parts indistinct. It is true that a bird's-eye view for half an hour from the top of St. Paul's church would enable an intelligent foreign staff-officer to draw up for his government a better plan and project for the occupation of London by its army, than he could have done had he meandered through its streets between St. Giles's and St. James's for half a day. For instance, from his exalted position on the sacred dome, he would be able to note down as a convenient cordon of encampment for the bulk of his sovereign's army—say, St. James's and the Green Parks, Hyde Park, Regent's Park, with any convenient open ground between Hackney and Bow, and between them and Regent's Park. He would briefly catalogue, as is usual, the churches which, from their respective localities, were best adapted to shelter men, and, if absolutely necessary, horses; and for the important object of enabling his encamped army to support and maintain a communication with that portion of it billeted in the City, the whole

line of houses in Regent Street, the large public buildings—such as Millbank Penitentiary, the New Houses of Parliament, the Horse Guards, Whitehall, the Admiralty, the National Gallery, and barracks adjoining—with the other great buildings round Trafalgar Square, as well as the Athenæum, United Service, and other club-houses about Waterloo Place and Pall Mall, would, in the usual routine of business, be scheduled to be strongly occupied by troops. To command the line of the Thames, which would of course be of great military importance, he would, according to ordinary rule, dot down the "new Midland" station (the largest space, I believe, ever covered by one roof), Somerset House, the Tower, St. Catherine's and London Docks, all of which nobody could fail to see are admirably adapted for barracks.

But, although the staff-officer could thus rapidly delineate a hasty project of the above description, for the occupation of the huge, wealthy, unfortified city lying prostrate beneath him, yet, from his position, it would be utterly impossible, and he therefore would not presume even to suggest the strategic movements of his army along or across, say 100 square miles of the surrounding country, the qualifications and features of which, either for attack or defence, when seen only in perspective, become impracticable for him to estimate. Give him, however, the opportunity of looking down only for a few minutes, not on a painted plan, but

on an accurate model or *fac simile* of the whole tract of country in question, and he would then be enabled to form and deliver to his general a more correct judgment on the quickest and safest mode of advance, both by lines and columns of infantry, cavalry, artillery, and supplies, than if he had attempted to ascertain the innumerable necessary details for such a report on horseback.

For the foregoing reasons, to all descriptions of spectators, and especially to young military students of fortification, a model not only gives a clearer, but a more enlarged and a more enlightened conception of the country it represents, than when from any one point it is viewed in its real dimensions.

The Royal Engineers' model room, situated in nearly the centre of the range of offices which form a portion of the northern boundary of the Brompton Barrack square, is a large theatre, comprehending a lower floor, open in the centre to the roof, with an upper story or gallery round three sides, throughout all of which, as well as below, are distributed a valuable and useful selection of models, open to all officers, non-commissioned, and sappers of the corps—as well as to every officer of every regiment and department in Chatham garrison; and I was moreover informed "that the corps is but too glad to show its contents to any officer of any country."

The object of these models is to illustrate to young Engineer officers, and to *all* sapper recruits, a course of preliminary lectures, while going through their course of instruction in field-works.

On these lectures the former are examined in writing after the completion of their whole course of instruction—the latter being catechised day by day thereon.

The advantages which both classes or ranks derive from these models before them are, that they are enabled to see, and practically to understand, the precise form and position of those very "field-works" of all descriptions, which, under the instruction and direction of the officers in charge of that department, they will shortly be required to execute, on full size, with tools, gabions, &c., models or specimens of which have been previously placed before them.

For the attainment of these important objects, in the hall or theatre have been collected, and arranged throughout its lower area and galleries, models of almost every system of fortification; of civil and military bridges of all descriptions; of barrel pier-rafts; of pontoons with their superstructure; of floating bridges, showing the various systems in use in England and on the Continent, as adapted either for public works, or for rapid field operations.

Specimens of mining and boring tools; also of complete sets of tools required by the sappers,

either as carpenters, wheelers, coopers, farriers, smiths, collar-makers, bricklayers, masons, painters, miners, or for entrenching.

Models of barracks, both for cavalry and infantry, as have been actually constructed under the supervision of the officers of the corps.

Tools for boring wells.

Models of Engineer materials required for siege operations, such as gabions of various descriptions, fascines, escalading ladders.

Models illustrating the different modes of sapping—double and single—as practised by the corps.

Models of different methods of loop-holing walls of farm-buildings, &c., and placing them in a state of defence; also showing how best to obtain cover from a house or walled garden.

Models of gun-carriages, with platforms of various descriptions.

Models of different descriptions of Martello Towers.

Models of fuzes for mining operations, both ordinary and submarine, with a small but indifferent collection of mineral and geological specimens.

Models of steam-engines of various constructions.

A model of Gibraltar, showing the condition of its defences at the time of its memorable siege, described by Drinkwater.

A model of siege operations against a regular front of fortifications—showing, on a very large

scale, the defensive and offensive works of both besieged and besiegers, with breaches in the several escarps of the former, especially in their salient angles, evidently executed by a veteran officer of great practical experience in the destructive powers of war.

Lastly.—The centre square already described, is almost entirely occupied by a large, low, billiard-looking table (20 ft. by 15 ft.), on which the students have a bird's-eye view of some square miles of agricultural country—with its houses, villages, hills, dales, high-roads, by-roads, hollow roads, streams, &c., in nearly the centre of which appear embossed, in all their details, the parallels, batteries, and approaches to a besieged fortified town, whose works, standing in bold relief, are accurately represented.

At a glance, the young Engineer officers, who, as I have shown, have all previously, both theoretically and practically, studied the subject at the Royal Military Academy,—as also the sapper recruit, who, *per contra*, has probably never seen or heard of it,—alike see before them, in this model, the process by which a well-educated army captures a fortress.

And although my attention has long been diverted from this subject, I will venture to submit to those readers who perhaps have never considered it at all, the following very few words of explanation :—

It may be observed, in general terms, that, excepting in small operations, where the invaders are inefficient in numbers, open towns (that is, not fortified) have *always* been given up at once to the master in the field: for instance, the best people in civilized Europe for the defence of houses and towns are perhaps the Spaniards, whose towns, containing convents, massive premises built of solid masonry, with flat roofs and covered balconies, afford great advantage for defence, especially to a people prone to desultory warfare, and to act together by general impulse; and yet the unfortified towns of Spain, such as Madrid, Seville, Salamanca, Valladolid, &c., although in all of them preparations were started and confident hopes of self-defence entertained, were *always* given up to any French army in force.

At Berlin, Moscow, and Vienna, where every man is more or less a soldier, no resistance was offered. Even at Paris, containing an army of well-equipped soldiers of the National Guard, its defence was not attempted. And, although, in the subsequent insurrectional street-fighting, from the lukewarm attacks of the troops, who eventually joined the defenders, a temporary success was obtained, yet, so soon as the army became stanch, the *barriers* proved of little account.

But as regards a regularly fortified town the case is different.

"Fortification," as defined by Vauban, "is the

art of enabling a small body of men to resist *for a considerable time* the attack of a greater number," from which definition it may logically be inferred, what is practically the case, namely, that *after* "a considerable time" the lease or life or strength of the art of fortification having expired, the fortress by which it had been defended, surrenders.

Of course it will be remarked that "a considerable time" is an indefinite expression, and by Vauban it was purposely left indefinite, because the duration of a siege is lengthened or shortened by,—1st, the amount of its powers of resistance, that is, by the nature and arrangement of its works, and by the strength or weakness of its garrison.

2nd. As compared with the above, the preponderating force of men, guns, mortars, and siege materials of the besiegers.

But, whatever may be the result of the comparison, just as all men, however stout, sooner or later are sure to die, so is an ordinary fortress, whatever may be its strength, predestined to surrender, after it has "resisted for a considerable time the attack of a greater number," provided always that that "greater number" has been sufficiently great, and that they have approached their victim with a supply of siege artillery and materials adequate to their professional requirements.

With these advantages given, the result of the attack, be it fast or slow, is just as *sure and certain*

to end in the surrender of the garrison as was the policy, or "military arithmetic," of the Federal General Grant, who, on finding that his army tripled in number that of the Southern States, resolved, without very much caring about a day's victory or defeat, to "go hammering on" killing man for man, knowing that the bloody process (he lost in Virginia alone 150,000 men) must inevitably end, as it did end, in *the exhaustion of his opponents.**

When a fortress is known to be provisioned for an insufficient period, it may be reduced without blood-letting, simply by cutting off by a tourniquet, or, as it is termed, by investment, the supplies which nourish it; in which case the garrison, after undergoing "the horrors of war," *i. e.* almost starvation (at the siege of Malta, the French garrison, on the 2nd of September, 1798, after having held out for two years and two days, before they yielded, nobly ate all their mules, asses, and rats), surrender.

Again, in the Russian war, the defenders of Kars were so weakened by famine, that great num-

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* The Surgeon-General of the United States, in his Report lately published, has stated:—

"Surgical operations were performed on wounded soldiers in the first two years of the war. . .	187,470
"Amputations followed by death	9,705
"Number of deaths in the two years from disease alone	56,193

"Number of cases, including wounds, in 1862, was 1,711,803."

Besides the above loss of men the Northern States spent 1000 millions sterling, of which 600 millions have been borrowed by the Federal Government.

bers of them could not carry themselves, much less their arms, when they surrendered "with all the honours of war."

If the supplies are *sufficient*, the process is precisely that so clearly illustrated in the great model before us.

As a meagre outline of the practical knowledge which, by the assistance of these models, the Engineer officers whose duty it is to lecture are enabled to impart to their students, as standing all round they look down upon their details, for the information of a few readers unacquainted with them, I will continue to explain, that so soon as a besieging army, with its siege guns and ponderous requirements, has approached almost within range of the guns of the doomed fortress (that is, "*doomed*" unless an army marches to its relief), their first process is, during the night, to draw up—with their feet touching a white cord laid down by an Engineer officer—a line of soldiers, who, with spades in their hands, and well protected in their front, set vigorously to work, in darkness, to dig a "trench," the earth of which, thrown into a bank or line of gabions (empty circular baskets standing with their mouths open and on their ends), forms a *parallel*, which at daybreak is a good deal too visible to the besieged.

The object of this parallel is of course to contain, by day and by night in all weathers, protected soldiers sufficient in numbers to defend the trenches,

as also batteries constructed in or near it to subdue and eventually silence, to a certain degree, the artillery fire from the fortress.

As soon as this first foothold (defensive as well as offensive) has been firmly established, the next process is to construct, for the very same purpose, a second and similar parallel about half way between it and the doomed fortress.

But as this second parallel, within musketry range, is too close to the enemy to be laid again by the white-line process, which, even if it could be attempted, would isolate it from protection as well as from siege and all other supplies, the advance to its locality is effected by a continuation of short zigzag trenches, each directed by the Engineer, to point a little to the right or left of the fort, so as to prevent the enemy's artillery from raking or enfilading it.

When by means of these zigzags or approaches the second parallel, with its batteries both for guns and mortars, has been constructed, and when its artillery by very rough treatment has sufficiently succeeded in more or less silencing that of the doomed fortress, as likewise in battering its works, by similar process a third parallel, near to the crest of the glacis fort which covers the ditch of the body of the place, in spite of occasional sorties from the garrison which the besiegers have strength to repel, is established.

From this point, the whole approach to which

has been a sanguinary struggle, becoming day by day more determined on the one side, and more desperate on the other, two breaches in the enemy's escarp should be promptly completed. If the breach or breaches be not practicable, by a protected descent unnecessary to describe in detail, by a due mixture of mining and gunpowder they are made so, and, when so made practicable, the governor of the doomed fort is occasionally, by a flag of truce, invited to spare the further unnecessary effusion of human blood by a surrender.

If he refuses, or, without any such appeal to him, if he resolutely continues his defence, the assault—the last scene in the fifth act of war's bloody tragedy—is arranged and ordered. And now, casting aside what the reader may possibly have considered to be "fancy's sketch," I will lay before him as a *stern reality* the following short extract from 'Journals of the Sieges in Spain, by Colonel Sir John T. Jones, Royal Engineers,' describing one of the nine principal "assaults" therein enumerated; which I have selected, simply, 1st, because, although it is not the most sanguinary, it is narrated in the fewest words; 2nd, because it was executed in darkness; and 3rd, because it delineates the picture of a great commander writing (in outward appearance only), as calmly as if he were smoking a cigar, the death-warrant of a portion of his army:—

EXTRACT.

"In the afternoon, the tower being nearly beaten down, and the main breach rendered extremely good, Lord Wellington, after a close reconnaissance of both breaches, decided to give the assault in the evening; and sitting on the reverse of one of the advanced approaches, wrote the following order for that operation. In the mean time he directed the fire of the batteries to be turned against the defences, which was done with considerable effect.

"ARRANGEMENTS FOR THE ASSAULT

(*Written as above described by Lord Wellington.*)

"The attack upon Ciudad Rodrigo must be made this evening at 7 o'clock. . . ."

(Here follow a continuation of orders in detail, signed "W.," occupying almost three octavo pages of print. (See Appendix A.)

"Immediately," continues Sir John Jones, "it became dark General Picton formed the 3rd division in the first parallel and approaches, and lined the parapet of the second parallel with the 83rd regiment, in readiness to open on the defences. At the same time General Craufurd formed the light division in rear of the convent of St. Francisco, and the other detachments for the assault paraded agreeably to Lord Wellington's memorandum.

"At the appointed hour the attack commenced on the side of the place next the bridge, and immediately a heavy discharge of musketry was opened from the trenches, under cover of which 150 sappers, directed by Captain Macleod and Lieutenant Thompson, of the 74th regiment, advanced from the second parallel to the crest of the glacis, each man carrying two bags filled with hay, which they threw down the counterscarp into the ditch, and, having reduced its depth from 13½ to 8 feet, fixed the ladders upon the bags. Major-General M'Kinnon's brigade

followed close in rear of the sappers, and immediately jumped upon the bags into the ditch; the garrison, who had prepared and ranged a vast number of shells and combustibles at the foot of the breach, and on its ascent, precipitately fired them, and they therefore spent themselves before the troops reached the sphere of their action.

"General M'Kinnon's brigade instantly pushed up the breach, in conjunction with the 5th and 94th regiments, which arrived at the same moment along the ditch from their right. The men mounted in a most gallant manner, against an equally gallant resistance, and it was not till after a sharp struggle of some minutes that the bayonets of the assailants prevailed and gained them a footing on the summit of the rampart. The defenders then concentrated behind the retrenchment, which they obstinately maintained, and a second severe struggle commenced.

"General Vandeleur's brigade of the light division moved from behind the convent of St. Francisco at the same time with the brigade of the 3rd division from the parallel, and during its advance received a heavy fire of musketry from the ramparts, by which Major-General Craufurd was mortally wounded.

"Bags of hay were thrown into the ditch, and, as the counterscarp did not exceed 11 feet in depth, the men readily jumped upon the bags, and without much difficulty carried the little breach, which, having no interior defence, was not obstinately disputed.

"The division, on gaining the summit, immediately began to form with great and most praiseworthy regularity, in order to advance in a compact body and fall on the rear of the garrison, who were still nobly defending the retrenchment of the great breach. The efforts of the 3rd division to force that retrenchment increased with their duration; and, after losing many men and officers thrown down the scarp into the main ditch, a depth of 30 feet, a desperate effort was directed along the parapet on

both flanks, which succeeded in turning the retrenchment. The garrison then abandoned the rampart, having first exploded a quantity of powder in the ditch of the retrenchment, by which General M'Kinnon and many brave men perished in the moment of victory.

"It is probable that the success of the column at the lesser breach had become known to the defenders of the great breach before the final effort which overpowered them, as they suddenly relaxed in their defensive efforts, individually dispersed, and sought refuge in the town, where they were pursued from house to house till all the survivors were made prisoners.

"The Portuguese, under Brigadier-General Pack, spiritedly escaladed the small redan in front of the gate of St. Iago, defended by a small guard, which they overpowered and bayoneted; but no attempt was made to escalade the main rampart, on account of its great height, and the double obstacle created by the fausse-braie.

"LOSS OF THE INFANTRY.

"The loss of the besiegers during the operation was 9 officers and 217 men killed, and 84 officers and 1000 men wounded. Of the above numbers, 6 officers and 140 men were killed, and 60 officers and 500 men wounded, in storming the breaches; amongst the latter was Lieutenant Thomson, the Engineer, with the third division."—*Journal of Sieges*, vol. i. p. 127.

The lecturer having explained to the young Engineer officers and sapper recruits the various uses to which the different models before, above, and around them are applied in the art of War, they proceed, as will be shown, to be instructed to execute and practise them, in their full dimensions, and with their own hands, in the Field.

DRILL.

I was lying wide awake on my barrack-bed, in my barrack-room, when the big bell of the barrack-clock, slowly commencing its first stroke of 5 A.M., was suddenly accompanied, rather than interrupted, by a young watchful bugler beneath it, whose loud, joyous, melodious *reveillée*, to which the monotonous clapper above him for a short period seemed to beat time, announced to officers and men the glorious addition of another new day to the military history of a veteran world.

In theory, and probably according to orders, every bed ought, I suppose, at this signal to be vacated; however, the bugler, for some reason no doubt well known to himself, in about a quarter of an hour awoke everybody again, the result of which reminder was that ere long I heard on the parade the heavy tread, occasionally at quick, but generally at "double-quick" time, of a considerable body of sapper recruits, undergoing that mental and physical process which, in due time, not only inevitably converts men into soldiers, but which, accompanied by gymnastics, ought, I argued to myself, for the following reasons, to form part of every national and rational system of education.

No animal, whether on four legs or on two, however he may enjoy life, can be of any use in the busy workshop of man, until he has been suf-

ficiently divested of that portion of his natural inheritance commonly called "*a will of his own.*"

What's the use of a cow, if she won't allow either man or maid to milk her? What's the use of a horse, if he won't put his head into a collar, or suffer a saddle to be placed on his back?

In like manner, of what use to the community is a man, in any rank of life, if he refuses to practise the heraldic motto of the Prince of Wales, "*Ich dien —I serve;*" in short, if the fellow won't *obey?*

Now as, in Mr. Rarey's hands, a couple of little straps proved sufficient not only to conquer *Cruiser*, but to divest numberless other horses, mules, and donkeys of that portion of their self-will which had made them useless, instead of useful, to man, so would a system of military drill in our public and private schools incline the rising generation of boys "to do their duty in that station of life unto which it shall please God to call them."

In the army, drill does not make a gang of recruits an ounce braver than when they enlisted; but, restraining rather than exciting their courage, it teaches them gradually to exchange their own will for that of their serjeant, captain, colonel, or general, until complete discipline welds these floating particles into a solid mass, which twenty times the number of equally brave but undisciplined men are utterly unable to resist.

But, as Mr. Rarey's principle is equally applicable to a rough Shetland pony as to a cavalry

officer's thoroughbred charger, so is military drill as advantageous to boys of all grades and professions as to their brother soldiers.

The dull-sounding but magic little words of command, "Eyes right!" "Eyes left!" "Eyes front!" "Right turn!" "Left turn!" "Right about turn!" "Quick march!" "Halt!" "Stand at ease!" "Attention!" &c., such as while lying in my bed I heard uttered sharply beneath me on the parade, instil into the minds of a lot of little boys the elements, not of war, but of peace. Instead of making them ferocious, to use Mr. Rarey's expression, these words "gentle" them, until, by learning to be subservient, not to their own, but to the wills of others, they become fit, in every possible department, to serve their country.

On entering the Foreign Office, Home Office, especially the Church, the Counting-house, the Manufactory, or the Farm, in which they desire to labour, their habit of *obedience* would prove so beneficial to their employers, as well as to themselves, that I feel confident, if a system of drill was firmly adopted in our public and private schools, a tall, undrilled young man, like a raw, unbroken horse, would, by the community, be considered as "*unserviceable*."

MILITARY DISCIPLINE.

LIEUT.-COLONEL FITZROY SOMERSET, R.E., Superintendent.

BRIGADE-MAJOR WARRAND, R.E., Assistant-Superintendent.

The reader will remember that the Senior Cadets of the Royal Military Academy at Woolwich, in their final Examinations for Commissions, were required by H. R. H. the Commander-in-Chief, "to drill the battalion in his presence, from manual and platoon, to battalion evolutions;" and as, from the age of eighteen to twenty and a half, they had been continuously serving in the ranks, either as private soldiers, corporals, or under-officers, practising almost daily drill, it must be evident that on leaving the Academy, they were as smartly set up, and in as high a state of discipline as the generality of young non-commissioned officers of the line of two and a half years' service.

Nevertheless, it has been very sensibly decreed that before being permitted to commence their third professional education,

ALL OFFICERS

on first joining the Royal Engineer establishment at Chatham, are to be placed under the orders of the Field Officer for Military Discipline, who is responsible that their uniforms are correct, and

strictly according to regulation, that their books, &c. are complete, and that they are acquainted with the standing orders of the garrison. Under him they are put through a complete course of Drill, including the use of the rifle; are instructed in the interior economy and management of a Company, and generally in the strict performance of their military duties, which they are educated to consider as the foundation of the character of their Corps.

Moreover, during their subsequent course of instruction, in order to maintain their discipline, excepting those on the survey and constructional courses, all are required to attend drill one day in each week, also Brigade Field-days; and the Field Officer for Military Discipline, by a standing order from the Director, is further directed to report to His Royal Highness, on the last day of each month, "the progress and attention of each officer under his especial command." The total time allowed for his military course is 105 days.

Lastly, before leaving the establishment, every officer is examined in his military duties (exactly as if he held a commission in the line) by a Board composed of field officers nominated by the General in command of the garrison, whose report is forwarded by the Director, to the Commander-in-Chief.

SAPPER RECRUITS

are enlisted from the age of eighteen to twenty-five years—

1st. *By External Measurement*, that is, they must be in height five feet six inches and upwards (one inch higher than is required for the line), and from thirty-three to thirty-five inches (according to their heights above the standard) round their chests.

2nd. *By Internal Measurement*, namely, they must be men of good character, able to read and write; and lastly, by actual trial in the trades to which they profess to have been brought up or apprenticed, their qualifications must be scrupulously and accurately tested.

The attraction of intelligent recruits to the Corps of Royal Engineers, is precisely that which attracts to the London police, to the Irish constabulary, and indeed to all trades and professions, men of superior attainments,—namely, liberal remuneration, as follows:—

In addition to their regular military pay, non-commissioned officers and sappers receive working pay according to their classification as workmen or artificers, for those days on which they are actually employed on the public works.

This classification depends on their skill and attention, and they are raised from one Rate to another, on the recommendations of the Captains of their companies, and of the officers under whom

they are employed. But, before they can be placed on the First Rate of working pay, they must be examined and declared qualified for it by a Board of Officers.

The working pay granted according to the different rates, is—

		s.	d.				s.	d.	
1st	Rate ..	2	0	per day.	4th	Rate ..	0	9	per day.
2nd	„	1	6	„	5th	„	0	6	„
3rd	„	1	0	„			(Rarely paid.)		

When under instruction when on Field-works, these rates are reduced to—

	s.	d.		s.	d.		s.	d.
1st Rate ..	0	9	2nd Rate ..	0	6	3rd Rate ..	0	3

On an average, the men of the Corps at the above rates earn in each week, in addition to their regimental pay and beer money, about four and a half days' working pay, which they do not receive when on guard, on the march, or on purely military duties; but, as when employed on public works, the pay of Sappers (defrayed out of the estimates thereon) is considerably less than that paid by contractors to workmen of similar descriptions, a body of Military Engineers are really, in these cases, a saving to the public.

As soon as they are enlisted, all Sapper Recruits go through a severe course of infantry drill, including gymnastics and rifle-shooting, which lasts four months, at the expiration of which they join the ranks of Sappers, and as such, become

entitled, in addition to their ordinary army pay, to the different rates of working pay above detailed.

The non-commissioned officers and men of the Corps are armed with a short Lancaster breech-loading rifle, with an elliptical bore, the lesser diameter of which is the same as the diameter of the Enfield rifle—length four feet not including its sword-bayonet.

HALLS OF STUDY FOR OFFICERS.

Each newly-appointed officer while at the Royal Engineer Establishment is required to go through six distinct courses, for which the following periods are allotted.

	Months.
1. Drill and military duties	3½
2. Survey course	6
3. Field-works and military bridges . ..	4
4. Architectural course	6
5. Chemistry	0½
6. Telegraphy and submarine mining ..	1
Total, exclusive of leave	21

The working hours of the Corps, as fixed by the Engineer Code, are as follows :—

From 1st March to 30th September,	9h. 50m.
„ 1st October to 31st October,	9h. 0m.
„ 1st November to 30th November,	8h. 0m.
„ 1st December to 12th January,	7h. 15m.
„ 13th January to 13th February,	8h. 0m.
„ 14th February to 28th February	9h. 0m.

The time allowed to the men for dinner is one hour, viz., from 12 to 1 o'clock throughout the year.

Before leaving the establishment each officer is examined—1st, in his military duties, as already stated, by a Board of Field Officers, no one of them an Engineer, and, 2ndly, in writing, in the six different courses he has studied.

The written examination paper of each officer, after due consideration, is then forwarded to H.R.H. Commanding-in-Chief, by the Director, with a confidential report describing his general qualifications, and also stating—as a useful practical record—whether he has shown particular aptitude for any special branch of his profession.

Young officers, although gifted with temporary commissions, are not permanently gazetted to the Corps until they have completed their course of instruction at the Royal Engineer Establishment; and accordingly, if through indolence they exceed the time allotted, their permanent commissions may at the discretion of the Commander-in-Chief be antedated to a date subsequent to that upon which they were gazetted to temporary rank. By this act they would lose the intermediate service, and with it, possibly, one or more steps in their Corps which, as the promotion is by seniority, would be, literally speaking, a life-long punishment.

COURSE OF INSTRUCTION FOR OFFICERS IN GENERAL AND SPECIAL SURVEYING, RECONNOISSANCE, ASTRONOMY, DEFILADE, SURVEY FOR DETERMINING LINES OF COMMUNICATION BY ROADS, RAILWAYS, AND CANALS.

LIEUTENANT-COLONEL FISHER, C.B., Royal Engineers Instructor.

LIEUTENANT C. HALKETT, Royal Engineer Assistant-Instructor.

ALL OFFICERS of Engineers are required to go through this course, for which six months, or 156 working days, are allowed.

For this object they are required to parade at the office at 8 A.M., to receive from the Instructor especial directions as to the work of each for that day, and the amount of progress, daily recorded, is reported each month to the Director of the Establishment, with remarks whether for each study the progress of each Officer has been on the whole above or below the time allotted for it, also whether it has been, or not, satisfactory.

As the young officers advance in the different branches of military science, in which they are here instructed, in order to test their progress, they are required to compose plans and designs, with a report in writing thereon of various descriptions—for instance, one of a fort, with an estimate of the amount of deblai and remplai,

with the probable cost of the earth-works, a scrutinising test of the knowledge acquired, of the delineation of ground upon a contoured plan, in fact, it is the practical application by the Engineer, of a most complicated work to a given site.

These plans and projects had, I observed, been carefully examined by the Chief Instructor, who had recorded upon them, in red ink, for a purpose hereafter to be described, remarks, several of which I copied into my note-book, as evidence of very efficient supervision.

The details, however, of this course of instruction are so numerous and abstruse, that, as I cannot altogether pass them over, or, on the other hand, attempt to enumerate them all, I will record a portion of them, which may be especially interesting to the reader, as having formed part of the course of instruction which Sir Robert Napier, as a young East India Engineer officer, practically received during his progress through the Royal Engineer Establishment at Chatham.

In reconnoissance the young officers (who at the Royal Military Academy had been well grounded in the preliminary principles of sketching) are here required to make a reconnoissance or military sketch on a scale of six inches to a mile, founded upon a base and system of triangulation, showing the position of towns, villages, churches, detached houses of importance, roads, streams, fords, bridges, &c., accompanied by a report in writing describing

among other details "whether the surrounding country is closely intersected with fences, and favourable or the contrary to the movement of the troops of an army. Whether with respect to any road included in their sketches there is any point where communication by it could be easily destroyed, either permanently, or by hasty demolition.

What number of troops or horses could be sheltered at a given position on an emergency, or for continuance, and the number and description of carriages and carts that could be provided.

Whether the country is well adapted for defence, especially noting any position that is capable of being rendered defensible speedily—whether each town or village in the sketch is close, open, surrounded by walled gardens, or other buildings which could readily be made defensible.

Whether there is any ground suitable for an encampment, either for a permanence, or for troops on the march, or any spot particularly adapted for a defensive position.

Which of the roads designated on the plan are capable of bearing continuous heavy traffic, and what means are at hand for their repair. Whether the information reported has been obtained from the officer's personal observation, or derived only from report.

Lastly, all proper names are required to be in italics, in characters sufficiently large to be easily legible to a man on horseback.

The following is a portion only of the synopsis of the amount of instruction Colonel Fisher is selected to impart.

THE SURVEY COURSE.

The course of surveying for the Officers of the Royal Engineers is intended to qualify them for carrying on survey operations of every description, and for designing and laying out engineering works, so far as these are influenced by the features of the ground on which they are placed, or over which they are carried.

The course consists of two parts: the one, relating to surveying processes exclusively; the other, to the uses made of the plans and maps, prepared by such processes, for engineering purposes.

Under the first of these divisions the officers are practically instructed in Astronomical, General, Special, and Reconnoitring Surveying, including the accurate delineation of the inequalities of ground by Levelling and by Contours traced instrumentally, and also the giving reliefs to hill forms by sketching with the pen and drawing with the brush.

Under the second division they are exercised in the adaptation of works of fortification to contoured sites; and in the selection and survey of lines of communication by roads, railways, and canals, and in drawing up projects for their execution.

ASTRONOMICAL SURVEYING.

The officers are taught the construction and use of astronomical instruments, and are practised in making observations with them.

They study from published works and memoranda printed at the establishment the most useful problems for finding

the Time, the Latitude and Longitude, the Direction of the Meridian, and the Variation of the Compass.

Examples of each problem are worked out by them from their own observations, or from observations made in their presence.

The use of meteorological instruments, and the reductions of the observations made with them, are also practised.

GENERAL SURVEY.

As a preliminary exercise in drawing, each officer constructs a plate of scales from data supplied to him.

For particular information on the delicate and powerful instruments and apparatus which have been used in great national surveys, and which cannot be studied in the establishment observatory, the officers are referred to published works; and they are instructed in the adjustments, the unavoidable errors of construction, and the powers of the instruments put into their hands, for the execution of their Survey Course.

The general survey comprises:—

1st. *The selection and measurement of a base.*—The base is measured with an ordinary chain and a 5-inch theodolite, and, this measurement having been reduced to its horizontal value at the level of the sea, the section of the base is laid down on paper.

2nd. *Triangulation.*—The measured base is extended by a triangulation over 10 or 15 square miles of country, and the relative altitudes of, and the distances between, the stations selected are determined from observations. The computed horizontal distances are laid down, and the azimuth of one of them is determined.

3rd. *Traversing.*—The positions of the roads, streams, boundaries of woods, and other marked features, surrounding and intersecting an area of six or eight square miles of the country triangulated, are then determined by running traverses with a theodolite from one station to another, so

as to cut up this area into spaces, which will admit of being filled in by a less accurate method, without introducing an error in the plan.

4th. *Plotting of detail and completion of the work.*—The protracted lines are now transferred to another sheet of paper, and the detail, obtained as the traverses proceeded, are plotted from the field-book. From this plot sketch-sheets are prepared, and the remainder of the work is sketched in with the aid of a prismatic compass, the form of the ground being represented by pencil strokes assisted by contours put in with the aid of a portable level. The sketch-sheets are etched in with a pen, and a finished brush-work plan of the complete survey, embracing all the information collected, is prepared from them, with the original plotted detail as a basis.

SPECIAL SURVEY.

A piece of ground, about half a square mile in area, is surveyed with minute accuracy as for some special purpose, and is laid down on a scale sufficiently large to admit of the calculation of the areas of the enclosures from the paper. The method followed is the same as that pursued on the Ordnance Survey, and with the Tithe Commutation Surveys, &c.

Contouring.—On the ground thus specially surveyed, contours are traced instrumentally at given vertical distances apart, and are plotted on the plan.

MILITARY RECONNAISSANCE.

This is conducted on principles similar to those which govern the operations of the General Survey; the instruments employed, however, are all portable. The measurement of a base is made by such means as readily offer themselves (generally by pacing), and the trigonometrical points are fixed simply by protracting angles observed with a box sextant, or compass. The whole of the re-

maining features and details considered necessary in a military point of view are sketched in with the aid of bearings and pacing. The reconnaissance embraces about six square miles.

In addition to the topographical sketch of the ground, each officers ends in a detailed report of its general character, its resources, and military capabilities, and illustrates it with a landscape panoramic view of its most important features, drawn in pen outline.

FORTIFICATION BRANCH.

Every officer is required, in this branch of the survey course, to design one or more works of defence for the occupation of a site, of which a contoured plan is furnished to him.

In performing this exercise the officer becomes expert in reading the various forms and slopes of ground, as expressed by contours; he meets with, and learns to provide for, some of the many modifications of the conditions of defence which the occupation of irregular sites necessitates; and he acquires facility in the application of descriptive geometry to the determination of the planes of defilade and the several planes of a work.

The data upon which the design is framed consist of a plan of ground, shown by contours, and of some of the conditions to be filled by the proposed fortification; such as the objects for which the site is occupied, the strength of the garrison, the extent of the works, the nature of the defence of the ditches, the trace, or the profile to be adopted, &c.

On the completion of his design, the officer writes a report explanatory of the character of the works he has adopted, and describing his arrangements both for the distant and near defence, with any improvements which have suggested themselves in working it out; and since the scale of the design admits of considerable accuracy in

its preparation, he is required to enter very fully into the detail of the arrangements he proposes.

The report is accompanied by tables showing how the remblai and deblai are equalized, and that the distribution of the latter is economical.

CIVIL APPLICATIONS.

Projects for a line of communication, general plan, and trial sections.—The officers are instructed in the general principles which should guide them in laying out lines of communication, whether by road, or canal, and are then sent out to examine the country between two points, from six to ten miles apart, and are required to decide on two or more routes which apparently offer the greatest facilities in point of gradients, soil, and the materials of construction. Availing themselves of the best map or plan they can obtain, they draw a plan showing, approximately, the divisions of the properties through which the trial lines are run; they then make trial sections; and from these sections and their previous examination of the ground, they determine on the line to be adopted—embodying in a report a general description of the country, the obstacles encountered on each route, the gradients, curves, &c., and also the calculations which led to their decision. In their calculations they estimate the cost of the necessary constructions on each of the trial lines, the cost of conveyance for heavy goods on an assumed basis of daily traffic, and the time occupied in each case for quick transit.

Working plan and section.—A length of one mile of the route determined on as the best is selected, and for this a special survey is made which is laid down as a working plan—the line being picketed out, when no objection is raised by the owners of the property through which it passes. A working section of the line is also prepared from accurate levels.

Plan of details, &c.—For the works proposed on that portion of the line which is included within the limits of the working section, a plan of details is prepared, as well as a specification for the works and an estimate of their probable cost.

THE SURVEY SCHOOL FOR THE NON-COMMISSIONED OFFICERS AND MEN.

The survey school for the non-commissioned of the Royal Engineers has been established in order to train sappers for employment on the ordnance survey of Great Britain; and to produce a number of men instructed in survey duties, who, being posted to companies of Royal Engineers, may frequently find opportunities during their service, especially in our colonies, of usefully applying their knowledge.

Admission to the school is obtained solely by volunteering. From time to time circulars are sent to all the home stations where Royal Engineers are employed, inviting both non-commissioned officers and men to volunteer for admission to this or any other of the "special schools" established at Chatham, and accordingly none but volunteers are admitted, and of volunteers, those only who by their qualifications are considered likely to become useful as surveyors.

The period during which they are under instruction varies from four to nine months, according to the extent to which it appears desirable to instruct each man, or, in other words, according to his capabilities for learning the whole work or only a portion thereof.

Each man on leaving the school is given a

certificate on which is stated his qualifications, in order that the officers under whom in any part of the world he may subsequently serve, may on its production at once read his value.

VOLUNTEERS FOR INDIA.

The non-commissioned officers and men of Royal Engineers who volunteer for service in the Public Works Department in India, are in like manner collected from the various stations where they may be serving, and are sent to Chatham to join the survey school, where, associated with the other volunteers, they are instructed in the various branches of surveying hereafter described.

On arrival in India they are sent to the different colleges established in that country, where they receive whatever further instruction may be deemed necessary to fit them for the special duties which they may be called upon to perform as overseers of public works.

As the abilities and attainments of the volunteer non-commissioned officers and men of the Royal Engineers, however equal may be their zeal, are, of course, very different, their course of instruction in surveying is divided into three parts.

The First Part only extends to the ordinary surveyor's practice of taking measurements with the chain and offset-rod, then laying down from

their field-book a simple chain survey, and lastly calculating the areas of the different enclosures therein.

The Second Part embraces more extensive operations of surveying—the uses and adjustments of the five-inch theodolite, Y spirit-level, and pocket sextant; they are also taught the principles of triangulation, and to lay down on paper the work done in the field or reduced from data there obtained—such as the reduction to their horizontal values of distances measured on slopes; the reduction of levels to a datum, and the plotting of sections therefrom; the calculation of the lengths of the sides of triangles from a measured base; and, generally, the solution of all the cases of finding the sides and angles of a plane triangle; laying down distances with a beam compass; protracting; traversing; drawing a fair plan with neatness and accuracy; and testing the work surveyed, by examination on the ground.

During this course they are also practised in recording and reducing meteorological observations.

The Third Part.—Whilst the above subjects are being proceeded with, the best draughtsmen are exercised, as opportunity offers, in geometrical drawing, and in drawing from sketches of hill forms, and from models. To this is added practice in sketching with the pocket sextant and prismatic compass, and in the representation from nature of

hill forms with the pencil and pen. Only those who show great aptitude, however, work without the aid of the pocket level and some species of contouring.

A small number of the most intelligent private sappers as well as non-commissioned officers are also taught the mode of obtaining altitudes by barometric measurement.

The *Volunteer* "special schools" at the establishment are as follows :—

1. Architectural.
2. Printing.
3. Survey and Topographical
4. Photography.
5. Telegraphic.
6. Chemical.

And as many people may reasonably imagine that the above studies, although they may strengthen the minds of volunteer students, must inevitably inversely weaken or dilute their discipline, I submit to them the following extract from General Simmons's printed volume of 'STANDING ORDERS,' dated 1st July, 1867, on that subject :—

"XIII. Non-commissioned officers and sappers, while going through a course of instruction in these (special) schools, are not available for any Regimental or Company duty, but are required to take charge of barrack-rooms, and attend all drill parades, and are expected by their smart and soldier-like behaviour to be a pattern to the recruits with whom they necessarily associate."

The reasons in favour of these "volunteer schools," are briefly as follows.

The sole object of a "Royal Engineer Establish-

ment" ought to be to enable it at all times, and especially during peace, to introduce, and gradually perfect in it, every large limb, branch, or twig of science that in time of war might be useful to our fighting army.

But in the attainment of this object it is, of course, necessary not only that the supply should be made equal to the probable demand, but that, on the other hand, it should not wastefully exceed it.

Now, the assistance which an army is entitled to require from its corps of Engineers and Sappers is composed of two ingredients:—

1. What it may *reasonably* be expected to supply —such, for instance, as an efficient pontoon train; water for men and horses; road-making across mountainous ravines, jungles, plains, or swamps; field-works, materials, and instructors for a regular siege, &c. &c.

2. What, although of immense assistance, it would be *un*reasonable to expect that the whole corps should supply—such, for instance, as mathematicians and first-class surveyors, travelling offices for printing, photography, telegraphy, &c.

Now, supposing that the Royal Engineer Establishment, either from over zeal or from under judgment, had attempted to force the *whole* corps of sappers to produce both these requirements, grasping at a shadow and losing a substance, they would have supplied the army with a lot of very inferior articles. The establishment therefore

resolved, I think wisely, to instruct the whole corps of sappers only in requirement No. 1, and to endeavour to supply requirement No. 2 by such sappers and non-commissioned officers as, excited by an innate genius for its component parts, might step forward as volunteers to study for the respective attainment of each. The result has proved creditable to both parties. Sappers from all parts of the world, voluntarily sentencing themselves to hard mental labour for from four to nine months, have converged upon Brompton Barracks, where, by Engineer officers ranking from low to high in their corps, and decorated for their services in the field, they have been, and now are, cordially, patiently, and efficiently instructed in the particular department of science self-selected by each.

ON ENTERING THE SURVEYING AND DRAWING SCHOOL, I saw before me a number of men dressed in bright scarlet. Several of them were serjeants and corporals, with stripes of distinction on their muscular arms; some had also medals on their breasts; two I observed buttoned up to the throat, but all without stocks, and were sitting opposite to each other, at long, broad deal tables, leaning over the different descriptions of plans they were drawing, several of which, I have no hesitation in saying, would in style and execution satisfy any of our distinguished civil engineers in Great George-street, Westminster.

Among those plans which were completed, I noted down as particularly well executed—

1. "A diagram of triangulation, with a table of scales of five feet to a mile—in feet, yards, chains, French feet, toises, mètres, furlongs, chains.

(Signed) "WILLIAM CARGILL,
"*Bugler, R.E.*"

Also, by the same, beautifully executed, 'Plan of the Hut Barracks, Brompton.'

"How old are you, Cargill?" I asked. "Seventeen and nine months, sir," he replied. The Serjeant-Instructor, Ingram, told me that this young sapper "was a good mathematician, working conic sections."

2. "A plan of Brompton, New Brompton, and Gillingham, showing the town, barracks, inner lines, great lines, St. Mary's Island, bounded on the west by the Medway.

(Signed) "JOHN KENNEDY,
"*Serjeant-Instructor, R.E.*"

3. "A plan of Trinity church, parsonage, and school," with gardens, trees, &c., beautifully executed by

"Sapper GILCHRIST."
(*A carpenter by trade, aged 23 years 6 months.*)

4. A detailed plan of hut barracks by Lance Corporal Martindale, aged 24½.

In the cupboards around the hall I noted surveying instruments, colour-boxes, drawing-paper, Chambers' course of Plane Geometry, ditto Mathematical course, ditto of Logarithms.

As, however, sitting ever so hard in a library of learned books does not always hatch a philosopher, I asked the serjeant-instructor, whether these books were or were not studied by sappers?

He replied (I copy from my note-book), "All those present are capable of solving trigonometrical calculations by logarithms: they understand the use of the prismatic compass and pocket sextant, the use of the theodolite, the spirit-level;" and he added that "many learn to take meteorological observations."

Finally, he showed me "a model for instruction of Fort George, Guernsey," bounded on the south by the sea, containing a fort in the centre, with surrounding country about four miles by six (that is, an area of 24 square miles), with its roads, houses, and villages.

This model, he told me, is used by the students as a study and for instruction in triangulation, surveying, &c. The men are also taught to make from it models, one of which I saw very well executed by

Sapper WILLIAM ROBERTS,

37th Company.

ELECTRICAL SCHOOL.

CAPTAIN STOTHERD, R.E.

In the Electrical School at Chatham *all* officers of the Royal Engineers, and a certain number of volunteers from the non-commissioned officers and sappers of the corps, are put through the following course of instruction:—

1. In the theory and general principles of electricity and its application.

2. In the construction and use of electric telegraph instruments, batteries, and apparatus. In the transmission and receiving of messages by means of these electrical instruments. In the construction and erection of permanent lines of telegraph, and in the application of the tests, and in the detection of the defects which may occur in the practical working of those lines.

As all Royal Engineer officers, previous to entering the corps, have acquired a certain knowledge of electricity, and as it is not requisite that they should become expert manipulators, their attention is confined to the principles of construction of the various instruments, and the action of electrical currents, so that they may, by their superior knowledge on these subjects, assist in the detection of any defects which may occur in the con-

struction or in the working of a line of telegraph. The time, therefore, for *their* instruction is comparatively short. But as the telegraph when constructed could not be worked unless their subordinates, the sappers, had become expert manipulators, the time allowed for the instruction and education of the latter is considerably longer.

On entering the school I saw before me sappers and non-commissioned officers seated opposite to each other on benches placed parallel to two long deal tables, on each of which were a set of telegraph instruments (one for each man), with batteries under each table, to supply them with the necessary electric current.

These men, arranged in the position of the front and rear rank of a line of soldiers, *i. e.*, with the face of one to the back of the other, instead of talking, were from opposite tables electrically communicating with each other, through a series of wires, which for the time represented to them the conducting wires of a telegraph.

After sufficient practice *vis-à-dos*, they are taught to communicate with each other in separate rooms, in which they can hold no verbal or visual communication with each other (by which arrangement a very young gentleman, locked up in the cellar, might communicate with the garret without disturbing "dear papa and mamma," sitting with the door wide open in the drawing-room); and the distance of separation is increased, thus teach-

ing them, step by step, to feel confidence in their power of communicating by electrical agency.

The instruments they are taught to use are the single-needle, the double-needle, the Morse recording and sounding, and the magneto-dial telegraph letter, by all of which the sappers are taught how to transmit and receive telegraphic messages.

The standard of proficiency required is by the needle instruments (both worked by the hands, read by the eyes) to transmit by the single one from fifteen to twenty words per minute, by the double one from twenty-five to thirty.

The "sounder," or spirit-rapper, addresses itself to their ears.

The Morse-recorder, repudiating the domination of both, asserts its independence by writing and promulgating its own story!

In the course of a few weeks the officers acquire sufficient knowledge of all these instruments. The non-commissioned officers and sappers, however, are detained six months, to acquire manipulation sufficient to enable them to act with an army or otherwise as telegraph clerks. Indeed, at present they are actually working as such, at Aldershot, Portsmouth, Gibraltar, Malta, St. Helena, Bermuda, and under Royal (Indian) Engineer officers the English sappers are almost entirely working the British telegraph through Persia.

TORPEDOES, OR SUBMARINE MINES.

Gunpowder, with its results, as thousands know, and as millions have felt, was bestowed upon mankind by Berthold Schwartz, a German monk. But in the voluminous history of manslaughter the name of the parson, or person, to whom we are indebted for the invention of torpedoes, that is, a mode of exploding heavy charges under water, for the purpose of destroying ships on its surface, is not, I believe, as yet inscribed.

The first recorded experiment occurred in October, 1805, in presence of Sir Sidney Smith, Admiral Holloway, and other officers, when one Robert Fenton blew up a 200-ton brig, off Walmer Castle, by torpedoes. Their ignition was mechanically arranged by priming-powder under a flint lock, the hammer of which was liberated by clockwork at the exact appointed time.

Fenton, receiving from the English authorities no encouragement, carried off his invention to the New York market.

In the Baltic, during the Russian war, floating torpedoes were made use of, but failed. The Chinese "Celestials" attempted some kind of infernal machine against us in the late war, but also without success.

As regards the establishment of a system, but

little in Europe has been done, except by the Austrians.

"Necessity," we are truly told, "is the mother of invention," and accordingly, in the late fratricidal American war, the government at Richmond resolved to use torpedoes, not only along their seaboard, but as obstacles to raids made by the Federal gunboats upon the rivers of the Confederacy.

In the early part of the war, drifting torpedoes were used. At first, two barrels of powder were floated down a river, towards the bows of a vessel. The barrels were provided with a lock and fuse, and were weighted and slung under buoys, so as to float twelve feet below the surface. They did not, however, succeed, and, other self-acting "motive" experiments having also failed, offensive torpedoes on this principle were abandoned. In lieu of them, the Confederates adopted *stationary defensive torpedoes*, which may be divided into three classes:—

1st. Torpedoes usually called "snake-runs," fixed at the ends of spars or "snags" anchored in a stream, or on piles driven into its bed.

2nd. Torpedoes, which, although moored to the bottom, float below the surface, to be fired by contact or by electricity.

3rd. Torpedoes lying at the bottom, to be fired by electricity only.

The amount of the charge varying according to

the depth of water, hard or soft bottom—and size of the vessel to be destroyed—was usually from 300 lbs. to 2400 lbs. of gunpowder. At Charleston the Confederates had a single mine at the bottom, of 5000 lbs., put into an old ship's boiler.

Of these three descriptions, the first was much used by the Confederates, especially in those swampy and pestilential localities in which the mosquitoes and snakes alone would have driven off their armed torpedo detachment necessary for observation and to fire the mines.

On the Roanoke river, in December, 1864, the second description (submerged detonating torpedoes) were used with great success.

To prevent the Federal gunboats from passing up to Weldon to destroy the railway bridges, one hundred of these torpedoes were moored in the river.

The Federal squadron of nine gunboats gallantly resolved to advance, in the hope of passing between them; but the invisible power was greater than the visible, and the result of the contest was that three of the invading gunboats were sunk and four irreparably disabled.

On the St. John's river in Florida, in 1864, by torpedoes exploded by detonation, three large Federal transports were destroyed, thereby causing the temporary withdrawal of the Federal force.

In May, 1864, the double-end Federal gunboat 'Commodore Jones,' 800 tons, was sent up the

James river to reconnoitre and drag for torpedoes.

"Then have thy will!"

was, in effect, the word of command of the Confederate officer, in obedience to which, on the Commodore crossing the fatal point, his vessel appeared first to rise and bend a little in its middle, then followed the explosion of its boilers, which sent everything above and around into the air, which, in the words of an eye-witness, "seemed filled with burning bodies and fragments," the splash of which as they consecutively fell upon the water—the place from whence they came—broke the appalling stillness which had prevailed. The officers and crew of the annihilated gunboat had amounted to 151, of whom the greater number were killed outright,—of twenty removed to a hospital, only three survived. As a remarkable fact, it was stated, that of the bodies not mutilated, all were found, on examination, to have their vertebræ broken, caused, no doubt, by the shock resulting from the mine. This single explosion, by checking the advance of the Federal fleet, gave General Lee time to throw a garrison into Richmond, thus undeniably saved—though only for a time—by a submarine mine.

On the 8th of September, 1863, the Federal flag-ship 'New Ironsides' came to a standstill exactly over a Confederate torpedo charged with 5000 lbs. of powder. Every effort was made to

spring the mine, but without success, and the iron monster, after reposing over it for an hour and a half, slowly steered away, the officers and crew quite unconscious—

> "That the sweet little cherub that sits up aloft
> Had looked out for the life of poor Jack!"

In another case, the Federal gunboat 'Commodore Barney,' commanded by Lieutenant Cushing, United States Navy, in steaming to Cox's Ferry, passed over two torpedoes charged with 3500 lbs. of gunpowder.

The Confederate officer, closing the electric circuit too soon, saved the vessel from being blown up; but the column of descending water, overtaking and overwhelming her, overturned her guns, washed overboard everything loose, stripped the mast of its rigging, and so distorted and loosened her frame—thereby opening her planking—that she could scarcely be kept afloat. In one experimental case, on the explosion of a submarine mine, without any apparent movement of the surface, nearly the whole of the bottom of the vessel was blown out, a column of water rising upwards through her sides.

By another explosion, fourteen guns on the main-deck of the Federal admiral's vessel the 'Minnesota' were dismounted, and several of the men thrown out of their hammocks.

The sum total of the Federal ships destroyed by

the Confederates was thirty-nine, not including other vessels more or less wounded.

Now, in the nutshell which contains these little figures, there lies concealed from the mind, not only of the British people, but of their leading statesmen of all parties, a great moral, or, as it might truly be termed—a torpedo—which, if it remains any longer disregarded, may, in the case of England being forced to go to war, be attended with results infinitely greater and more calamitous than those smaller explosions just described.

The moral I allude to is this—"Why, of the two Transatlantic belligerents, did the weaker one completely overpower the stronger one—so far as regarded the use of torpedoes?"

The plain answer which now vitally applies to England is, simply because, while the weaker power opened its eyes to science, the stronger one, neglecting the engineer's art of defence, kept them shut.

In May, 1862, the Confederate submarine mining operations (placed originally under Captain Hunter Davidson to form the nucleus of a regular system), a mining bureau was constituted at Richmond, to which was attached, by order of the Government, General Raines (the inventor of composition for detonation), assisted by a staff of one captain and two lieutenants, with power to select from the infantry, navy, and also from civilians, the requisite amount of officers and men, possessed with the

special qualities required, namely, education, discretion, nerve, and courage.

On the James river, the submarine mining establishment consisted of two large tugs, a store-vessel, six torpedo boats, with four waggons and six ambulances, for moving the mining staff and batteries from point to point. Whenever more waggons were required, they were, by order, supplied to the mining bureau by the Quartermaster-General of the army.

While this scientific organization was producing its effect as surely as seed sown in cultivated ground produces a harvest, the large, rich, powerful Federal government, although their vessels actually before their eyes were either blown upwards or made to disappear downwards, for a considerable time ignorantly neglected to arm themselves with a simple, cheap, new weapon, powerful for offence, and still more powerful for defence.

Now, are not Austria and England—to say nothing of the American government (who since the war have atoned for their error by establishing a torpedo system which has lately equipped five large vessels with torpedo arrangements, and for investigating the laws relating to submarine mining in general)—at this moment precisely in the same relative position, as regards the scientific knowledge and use of torpedoes, as were the Confederate and Federal States at the period above described?

In the former region, by order of its Emperor,

its engineers, under Baron von Ebner, have developed a complete system of submarine mining by gunpowder, and have, moreover, tried gun-cotton for that purpose.

Yet, with all this experience, and with all these facts before us, what precaution during peace is Britannia, on whose empire the sun it has been said never sets, taking to protect herself by those submarine batteries which even almost an inland nation, before her eyes, is adopting? What system of fortification, it may be asked, is that which readily spends millions on strengthening the surface of water, and yet shrinks from a trifling expenditure for rendering that surface dangerous of approach from beneath?

Of all the nations on the face of the globe, it may truly be said that a submarine protection is of the greatest importance to England, who, in the case of being forced into war, would find herself exposed to two dangers; the one, *invasion* by an army—comprehended, if the enemy was European, within a few miles—the other extending without metaphor or exaggeration to the world's circumference.

To guard our home coast, and that of all our distant colonies, by ships of war or by fortifications would of course be impracticable.

They would therefore be liable to two different descriptions of attack:—

1st. By the vessels of war of our enemy, which

our navy might be deemed competent, and which they would be but too happy to encounter.

2nd. By single fast-sailing men-of-war, as also innumerable privateers, who, avoiding our fleet, our forts, and our large vessels of war, would amuse and enrich themselves by suddenly running up some estuary, or anchoring before some rich defenceless town, which, to avoid being bombarded, would of course prefer to pay them the demanded ransom.

But, supposing that England, like Austria, and like the United States, had a regularly well appointed scientific system of national submarine defence—directed by a sufficient body of well-trained officers and men, ready at a moment's warning for service either at home or abroad—the torpedoes, &c., for which could, in case of expected war, be very quickly amassed and distributed, we should at once obtain, in the very hour of our dire necessity, a species of invisible fortification, which, for the very reason of its being invisible, would have the terrifying effect of the old-fashioned notice-board "Man-traps and spring-guns are set on these premises" (the board carefully avoiding to say *where*).

An enemy's fleet where torpedoes were thinly sown might possibly accept the fortune of war, and gallantly advance. But the knowledge, and what would probably prove more valuable, the *fear* of touching or sailing over one of these torpedoes,

would, so far as regarded single vessels and amateur privateers, not only effectually spoil the pleasure of popping in and out of our wealthy harbours, channels, estuaries, or rivers, to fill lockers with comfortable plunder, but would render them all harbours of refuge to our own shipping.

For a torpedo has this extraordinary advantage, that, although as much out of human sight as a mole underground, he knows the difference between his friend and his enemy, and therefore, while he allows the vessel of his own country to pass harmlessly over him, he is, by the magician who commands the electric wire, gifted with power instantly afterwards either to blow into the air, or, what is an equally efficacious prescription, to blow a hole in the bottom of any hostile vessel that dares to pass over him.

This invisible power of defence would render every British port, estuary, or river, whether at home or in our colonies, a harbour of refuge to which fast-sailing merchant vessels, when chased, might safely run, knowing that the submerged mines over which *they* could pass safely, would present an impassable barrier to their pursuers.

Repeatedly during the Russian war, General Sir John Burgoyne, while director of siege operations in the Crimea, and afterwards in England as director-in-chief of the corps of Engineers, strongly urged the use and adoption of submarine mines.

A memorandum on this subject addressed by him

to the Secretary of State for War, on 20th July, 1863, led to the formation of a committee, appointed jointly by the Admiralty and War Office, in September, 1863. This committee, after carefully deliberating on the best means of arranging a system of torpedo defence, have reported, and the further investigation of this subject has been referred to the Director of the Royal Engineer Establishment at Chatham.

The discarded child whom nobody for a considerable time would own, thus at last found in Major-General Simmons a patron, and in the Royal Engineer Establishment at Chatham a home, in which, assisted by the experience of the late Royal Commission on floating obstructions, and by Mr. Abel, F.R.S., chemist to the War Department, he is now domiciled, nourished, and educated by a process, a mere outline of which I will endeavour to delineate.

FLOATING ELECTRICAL SCHOOL.

Captain STOTHERD, R.E., *Instructor.*

The object of this school is to elaborate all the details necessary for applying submarine mines in all their varying circumstances of tide, depth of water, and force of current; to reduce these details to a system, and, by a course of instruction, to train the Royal Engineer officers and men to work that system. Now, these details involve the

consideration as to whether the mine should rest on the ground at the bottom, or be held suspended in the water in a given position beneath the surface, also the speediest and most expeditious method of placing and arranging torpedoes with reference to the space or locality to be protected, so that, for instance, in a channel perfectly protected by them, no ship should be able to enter without being destroyed.

They also involve the means of firing, which as a general rule ought to be so devised that the mines should be harmless to friends, fatal to enemies; for otherwise our own ships, or friendly ones, would not confidently run for refuge to a friendly port.

The submarine mine consists, as already described, of a charge of explosive material, such as gunpowder, gun-cotton, or any other similar agent, placed in a case of sufficient strength to preserve it from the water, and, moreover, to withstand the rough usage it receives in mooring.

In contact with the charge of powder or other explosive is inserted a fuse, which, on being fired, ignites and explodes the charge, heaving up a column of water which varies in diameter and height according to the amount of the charge, and the depth at which it is immersed at the moment of explosion. Charges so exploded, if of sufficient amount, are capable of destroying ships of the largest size and weight.

As the Submarine Floating School, established by General Simmons, was of course beyond my reach either on foot or on horseback, I embarked with him on board what is called a "twin-screw" steam-launch or boat, kindly lent by the Admiralty for the use of the Engineers, accompanied by Captain Stotherd, who—carefully nursing in his arms a certain mysterious-looking mahogany box, which I was not particularly desirous to touch—bears precisely the same relation to every other officer in the corps of Royal Engineers as *gymnotus electricus* does to the common eel.

Nothing could be more perfect than the action and discipline of the active little engine that, exactly like a soldier at drill, advanced, turned to the right or left, marked time (*i.e.* halted), or suddenly went right-about or left-about at the word of command.

After twisting in, at a nimble pace, through craft of various sizes and descriptions, it approached and soon brought us in sight of the Floating School, moored close to an enormous black other floating something such as I had never before witnessed, (the last-born child of the Admiralty), Her Majesty's armour-plated steamer "THE HERCULES," weighing with all her complement on board, 8381 tons (rather more than the weight of an army of 134,000 men of 10 stone each), 339 feet in length, mounting in a turret on her deck 8 guns, weighing each 18 tons, fed with

an iron bolus or shot weighing 300 pounds, propelled from its mouth by 45 pounds, *i.e.* half a barrel, of gunpowder. Moreover, in lieu of eyes, two heavy guns, one a bow-chaser, looking out ahead, the other a stern-chaser, looking out aft in the opposite direction, each and all protected by armour-plates. "*She*" (a gender which the Lords of the Admiralty, I think, rather doubtfully apply to "Hercules") has a double bottom, four feet separate, of iron inside and out, in water-tight compartments, so that no single blow can destroy it unless it breaks through both. Throughout her whole length not a port-hole is to be seen, and, when laden for service, but a small portion of her armour-plated sides, surmounted in the centre by the turret with its garrison who work and fight her iron-shielded guns.

With feelings of awe and astonishment, which it would be difficult for me to describe, as our tiny steamer advanced, I sat gazing at the enormous floating iron fortress towering above us.

"Now," said General Simmons to me, with a look of placid rumination, pointing to the great black mass, and then to his own little "floating academy," "what's in our mind's eye, and what we have to learn, is, *how to be able to blow up the Hercules.*" Just as if I had been sitting in the House of Commons, I instantly "took down" these "offensive words," adding to them (as any one may read in my note-book), "A Herculean task!"

and I believe the reader will not be disposed to deny it.

With malice prepense therefore we steered from our gigantic victim to the tiny Royal Engineer Floating Experimental School, an Admiralty mooring-lighter fitted with a derrick and davit for mooring, such as is used in our dockyards.

On ascending its sides, we found its population to consist of a Corporal R.E., and two sappers, in charge of the stores and apparatus, consisting of cables and anchors of various patterns, iron cases for explosive charges under water, with an electrical apparatus for igniting and exploding them.

About 100 yards to the west was moored a raft formed of a heavy staging of timber, connected by four line-of-battle ships' topmasts, which on measurement I found to be ninety-five feet long, and resting on two iron mortar-boats, built in 1856 for service in the Baltic.

On this staging stood upright, like a gallows, a pair of heavy shears, to which was suspended the shattered corpse of a target constructed (in the Dockyard for the Royal Engineers) of a wrought-iron frame or gridiron, upon which was affixed, for experiments, a wooden front, the thickness of which can be varied at will. The rear of this gridiron was composed of iron plating, backed by wood, the intervening space forming a series of water-tight chambers.

By the above arrangement, an air backing to the target was obtained, against which experimental charges could be fired, on conditions somewhat similar, in principle though not in degree, to the hollow sides of the Hercules lying alongside. I observed, as the result of the last experiment, that the wooden casing of the gridiron had, by a submarine explosion, been shivered throughout to atoms, leaving nothing but the skeleton of its construction.

Attached to the Royal Engineer "floating school" is a man-of-war's pinnace, 38 feet long, fitted for laying the submarine moorings, and worked by sappers.

To those accustomed to blue-jacket sailors it would have been, as it was to me, striking, to see a man-of-war's pinnace manned by soldiers with moustachios, each wearing a blue forage-cap, with yellow band (secured by a black patent-leather chin-strap), cocked on one side of his head, a white shirt tucked up at the sleeves, dark trousers striped down the legs with bright scarlet, smartly giving or obeying the words of command, "man the winch," "hold on," "take a couple of turns," "ease off," "pay off the bow anchor," &c., all of which I heard.

The delicate, difficult, and scientific manipulation for igniting the fuse, as directed by Captain Stotherd, though highly interesting, I will not venture to describe. But in testimony of its

results it is proper I should state that I witnessed, as a part of General Simmons's siege operations, an experimental explosion not far distant from the floating school, by which a supposed enemy's bark, distant from him three-quarters of a mile, at his word of command enveloped in a great column of water, was blown in black fragments upwards of 30 feet into the air.

General Simmons's floating school is at present, it may be said, only in its infancy. The small amount of knowledge and practice it has already acquired sufficiently however demonstrate that, if this submarine mine establishment were to be properly—that is powerfully—supported by Her Majesty's Government, it would soon develope a system of submarine defences which could be readily applied at any moment to produce cheap and valuable defences for harbours, rivers, estuaries, seashore towns, &c.

The Admiralty, in like manner, are, I believe, to an equally small extent, establishing a system for the guidance, application, and explosion of "motive," or *offensive* torpedoes. And as men of science admit of no distinction between the wearers of blue jackets and of scarlet tunics, the combined experience and cordial co-operation of both would, it must be evident, prove highly beneficial to the safety, honour, and welfare of Her Majesty and her dominions.

If this system were fully established, there would

then be but two ways in which an enemy could accomplish the passage of a channel defended by these hidden "*ship traps*," namely, either to cause them to their own destruction to be exploded, and so clear the passage—or to endeavour to remove them. Now as the power of explosion is entirely in the hands of the invisible electrical operator acting on the defensive, it is clear that he will only explode them for an adequate object, such as the destruction of a ship of war, or vessel calculated to do serious injury. Of course each explosion would make in the line of defence a small breach, the position of which, although accurately known to the defenders, would be very difficult to be determined by the assailants, as it leaves no mark or beacon to guide a second ship through the defensive line, while a slight divergence to the right or left would bring it above a second mine—that is, into a second trap. It is probable therefore that a first explosion in a well-laid line of defensive mines, although it would make a breach, would not make a practicable one. To prevent small boats from attempting to drag for the mines, guns, especially those Dahlgren monsters which, like torpedoes, can now be made to lie latent until they think proper *vivâ voce* to proclaim themselves, would be most valuable as accessories.

ROYAL ENGINEER TRAIN.

LASSO-DRAUGHT FOR CAVALRY.

Captain DUFF, R.E., *Commanding.*

A STRANGE HISTORY.

The vast plains of the Pampas have three descriptions of inhabitants,—namely, a very few gauchos, an innumerable amount of horses, and about an equal quantity of what ungenerically may be termed bullocks.

Now, for the purposes of draught, the first has availed himself of the two latter, by making the wild horse draw with a single trace or lasso hooked to a surcingle girth, both cut with his own knife and made with his own hands of raw (*i. e.* untanned) bullock's hide. Horse-power therefore, on the Pampas, may be said to be composed of two living animals, plus the skin of a dead one.

In one of my four journeys on horseback across these plains I accompanied a coach drawn usually by six horses, and a cart with enormous wheels, 9 feet in diameter, drawn by four, all without collars or harness; and as we traversed this wild uncultivated region at a gallop* (occasionally only retarded in our pace by four rivers, some miry swamps, and a shallow lake) as straightly as if we

* During my residence in South America I never once saw a gaucho trotting a horse; he knows of no pace but the fast canter or gallop.

had been following a pack of hounds, I might be permitted to testify to the efficiency of lasso-and-surcingle draught.

However, as a single case ought never to be permitted to constitute a "rule," I will at once state, as a firmer basis, that when I was in South America not only all the merchandize and all the travellers that had ever crossed those vast regions, but all the artillery waggons and supplies for men, had been transported as has been described by General Miller in his 'History of the War for Independence,' as follows :—

"Our corps consisted of ten 6-pounders and one howitzer. Each gun was drawn by four horses, and each horse ridden by a gunner, there being no corps of drivers in the service. A non-commissioned officer and seven drivers were, besides the force already mentioned, attached to each piece of artillery. Buckles, collars, cruppers, and breastplates were not in use. The horses simply drew from the saddle, and with this equipment our guns have travelled nearly 100 miles a day."

On my return to England, forty-one years ago, I addressed to the Duke of Wellington a memorandum, in which, after simply describing the mode of draught I had witnessed, I submitted for his consideration :—

1st. That, as the single-trace-and-surcingle-draught had transported artillery, &c., across an *un*cultivated country, it would be at least equally serviceable on the roads and over bridges of cultivated countries.

2nd. That, as it is adapted to *un*broken horses, it would be at least equally applicable to trained cavalry horses.

3rd. That, as both surcingle and trace are made in South America of nothing but the raw hides of bullocks, we should, on active service, be able in all countries to use (instead of continuing to throw away as use*less*) this material ever present with an English army.

For the above reasons I submitted that, if not only our cavalry, but every saddle-horse receiving rations, were to be ordered to wear the South American surcingle, and to carry a halter of the usual regulation length, an enormous amount of horse-power, hitherto latent, could be developed —not for the purpose of harassing our cavalry, but simply to enable them to carry off any guns or treasure they might capture, or to give temporary help to our own artillery, &c., in (say) a steep ascent, or in crossing a short space of deep ground.

In reply to my memorandum, the Duke, after writing upon it the characteristic observation— "There is nothing like getting to the bottom of a thing"—required me to answer a few questions, which proving to him satisfactory, he came to Croydon, accompanied by Lord Fitzroy Somerset, Sir Willoughby Gordon (Quartermaster-General), Sir Alexander Dickson (who had been his ever ready and right-hand artillery officer in the Penin-

sula), and Sir James Carmichael-Smyth, late Commanding Engineer with his army in the Netherlands and France in 1815. Without entering into details, I will merely state that with horses trained and untrained, half-bred and thorough-bred, he saw a waggon heavily laden with iron taken at a fast canter over uneven ground; and, as a proof of his opinion of the importance of introducing cavalry lasso-draught for occasional purposes, on the ground he recommended Sir W. Gordon, the Chief of the Staff Corps, to promote me, without purchase, from half-pay of the Engineers to full-pay in that corps, which he did.

From the officers assembled by the Duke I received notes, of which the following are extracts :—

1. From Colonel Sir Alexander Dickson, Royal Artillery.

"MY DEAR SIR, "*Woolwich, July 8th*, 1827.

"Ever since your trial on Thursday last, I have been turning over in my mind the great advantages to be derived from the operation of the method of draught you have proposed; and as I am satisfied it may be made of infinite benefit to Ordnance field service, and in movement of battering-trains, I trust you will lose no time in bringing the idea to the notice of the Master-General of the Ordnance, for the purpose of the system being considered by the Committee at Woolwich.

"I remain most truly yours,

(Signed) "A. DICKSON."

2. From the Quartermaster-General.

"DEAR SIR, "*Horse Guards, July 17th*, 1827.

"You have most satisfactorily established the utility of the principle that the mode of drawing with the lasso can be applied to every sort of draught, and with every sort of horse.

"I believe the Duke of Wellington is perfectly satisfied of that, and so was every person who saw the trial.

"You have also established what is of great use to know, that the rough material of bullock's hide in its raw state can be used for such purpose at the shortest notice, indeed, as soon as the animal can be flayed.

"Yours sincerely,

(Signed) "W. GORDON."

3. From the late Commanding Royal Engineer with the Army in France.

"*Nutwood, Reigate.*

"MY DEAR HEAD, *July* 22, 1827.

"I am convinced that a few months after you get an authority to go to Woolwich with your lasso it will be established. I had no idea of the wheel-horses holding back in the way I saw, nor of the facility the lasso and surcingle afford of attaching any number of horses to the rear of an ammunition waggon or a heavy gun while descending steep or precipitous ground. The more I reflect upon the subject, the greater its advantages appear.

"Very faithfully yours,

(Signed) "J. CARMICHAEL-SMYTH."

A subsequent inspection of the lasso system of

draught by King William IV., on the 28th July, 1831, was thus described in the Windsor paper :—

"Shortly after three o'clock the King arrived on the ground accompanied by the Landgravine and the Princess Augusta, and followed by three pony phaëtons, containing the Duchess of Saxe-Weimar and her family, Lord Holland, Lord F. Fitzclarence, and the young Princes (the present Duke of Cambridge and the present ex-King of Hanover), the Marquis of Douro, Sir Andrew Barnard, and other distinguished personages were present.

"Major Head's first experiment was to recover and carry off an ammunition waggon, supposed to be left behind in a retreat, and which, but for this new application of power, must be relinquished to the enemy.

"At his word of command a body of the 9th Lancers rode up to the waggon, and, fixing a cord with a hook at the end of it to the pole, they galloped off with it at full speed.

"A heavy car containing a serjeant and fifteen men of the Coldstream Guards was (by four men and horses of the Life Guards) drawn for a considerable distance by the same means, and when halted, the cavalry disengaging their lassos from their horses, and the infantry at the same moment dismounting from the waggon, both forces advanced and charged together. This movement, which was executed with great rapidity, showed that, by means of drawing from the surcingle, horse and foot may be made to co-operate.

"A 6-pounder field-piece was in like manner carried off at full gallop, and with comparative ease, by only two cavalry horses; and a heavy truck containing straw, &c., by one horse.

"A bull, whose horns had been entangled by the lasso, was then dragged forward by two of the cavalry, and car-

ried off at full trot, all the resistance of the animal being ineffectual.

"Several distinguished officers on the ground expressed a decided opinion as to the successful result of the experiments, and considered that the introduction of Major Head's plan into our military tactics would be attended with considerable advantage to the service."

The King expressed himself to me, *verbatim*, as follows:—

"Sir, I have been very much pleased. Sir, I have been thinking what Frederick the Great, if he could put his head out of his grave, would say to see household troops drawing a waggon; but we live in an age of improvements. I am much obliged to you. Sir, I am very much obliged to you indeed."

Suiting his actions to his words, I received from his private Secretary, Sir Herbert Taylor, a communication asking me whether I would prefer to receive a step by brevet in my profession, or to be knighted. I selected the former; but some professional objections being made to "the extreme embarrassment it would create," so far as regarded my professional and civil prospects, I was at one and the same moment both benighted and knighted.

The Duke of Wellington, after due consideration, recommended to the King that his cavalry should adopt the lasso principle of draught to a limited extent.

His Majesty's order for its adoption was as follows:—

Extract from the King's Regulations.

52. *Lassos.*—It is important that the cavalry should, upon emergencies, be available for the purposes of draught;—such as assisting in dragging artillery, &c., through deep roads, and in surmounting other impediments and obstacles, which the carriages of the army have frequently to encounter in the course of active service; a portion of each regiment (not less than ten per troop) is therefore to be equipped with the tackle of the *Lasso*, a pattern of which is lodged at the office of the Consolidated Board of General Officers, where commanding officers of regiments, and regimental tradesmen, may have access to it.

Without a word of comment on the above order, I will simply say that the project which I fancied had thus bloomed, in a short period withered and died.

After it had lain buried for twenty-three years, I received from the Crimea, from General Sir John Burgoyne, two or three letters, requesting, on behalf of Lord Raglan, whose army, while its cavalry was comparatively inactive and while bullocks' hides were worthless, was severely suffering for want of *horse-power*, that I would assist them with immediate means for the application of lasso-draught.

To each of these applications I reluctantly but firmly declined to comply, explaining as my reason that without previous study and application a

valuable system of military draught would be as sure to fail, and thereby to be condemned, as would a quantity of boats and oars drown instead of assist landsmen totally unpractised in using them. In short, I submitted it was unreasonable to suppose that our cavalry, without adequate instruction, could all of a sudden be able to *drive*, merely because they were able to *ride*.

In 1857, that is three years afterwards, on the return of our army from the Crimea, Sir John Burgoyne, out of whose head no man's sledge-hammer could ever drive a useful project, being then Inspector-General of fortifications, resolved that the lasso system of draught should form part of the education of the Royal Engineer establishment at Chatham, and on his applying to me on this subject I of course readily supplied it with a sufficient number of raw hide surcingles and ropes (all, in compliance with his recommendation, paid for by Government), and with them I went to Chatham, briefly to explain to Captain Siborne, R. E., the officer in command of the mounted troop, how they should be applied.

The result which in a few weeks I witnessed was precisely that which might have been expected from a well-educated, highly scientific, zealous young officer, devoting his whole mind and time to develope a system of draught the simplicity and efficiency of which belonged not to him, not to the Royal Engineer establishment, not to Sir

THE ROYAL ENGINEER TRAIN PRACTISING CAVALRY LASSO-DRAUGHT.

London John Murray Albemarle Street.

John Burgoyne, but to the uneducated, intelligent gaucho of South America.

But the difference between the raw invention as I had seen it on the Pampas, and as it appeared before me in what may be termed Captain Siborne's manufactured state, was certainly very striking.

The power intrusted to him he had been unable to increase, but the scientific manner in which he had made it radiate (*see* sketch) in all directions, I felt, would not only have pleased the South American gauchos, but would have astonished them.

On the 24th of April, 1858, he exhibited to the Queen and Prince Consort, at Aldershot, a series of experiments of this character, at which Her Majesty expressed herself greatly interested and pleased.

The following extract of an official order—officially promulgated—expresses however a more definite opinion on the subject:—

(Copy.) "HORSE GUARDS,
"29th *February*, 1860.

"To Captain SIBORNE, Royal Engineers.

"SIR,

"His Royal Highness the General Commanding-in-Chief having at the request of the Secretary of State for War permitted you to retire from the command of the Royal Engineer Train to take employment at the War Office, he has directed me to convey to you the expression of his entire approbation of your conduct whilst holding that command.

"And he has desired me, in the most especial manner,

to inform you that he considers the 'Service' to be much indebted to you for the great variety of ways in which you so successfully showed with what practical advantage the lasso could be adopted in the army as a means of auxiliary draught.

"I have the honour, &c. &c.,

(Signed) "J. W. GORDON, Colonel,

"Dep.-Adj.-Gen. Royal Engineers."

Now the order which, throughout the whole reign of Her Majesty has been and is still annually repeated for its adoption, is as follows:—

Extract from the Queen's Regulations, p. 126.

Lassos.—"In order that the cavalry may, upon emergencies, be available for the purposes of draught, such as assisting artillery, &c., through deep roads, and in surmounting other impediments and obstacles which the carriages of the army have frequently to encounter in the course of active service, ten men per troop are to be equipped with the tackle of the lasso."

Lord Napier lately told me that the 3rd Dragoon Guards, commanded by Colonel Conyers Tower, had demonstrated the value of lasso-draught by rendering him "good service with it in India;" but, as regards our cavalry in general, I will merely state, as a fact exemplifying the precise rate at which Science marches in the British Army, that the expressed object of the Royal regulation above quoted for thirty-seven years has remained, and still remains, unfulfilled. And accordingly,

the Royal Engineer Train, whose officers, sappers, and drivers have their own duties to perform, has now restricted its lasso-drill, which, by Sir John Burgoyne's desire, Captain Siborne had expressly reduced to a system fit for cavalry (in case only they should desire to learn it) to the bare amount of instruction necessary for its own service.

SCHOOL OF INSTRUCTION IN FIELD-WORKS.

COLONEL WILBRAHAM LENNOX, V.C., C.B., Royal Engineers Instructor.

LIEUT. FRAZER, R.E., Assistant-Instructor.

As the object of field fortification is to enable an army, by the help of Science, if it be strong, to increase its strength, or, on the other hand, if it be weak, to diminish its weakness, it has been directed that all officers and men joining the Royal Engineer Establishment at Chatham shall be required to pass through this course, in which instruction is given in almost all the practical operations required by Engineers or service in the field, during which sappers, by a "standing order," are relieved from almost every regimental duty.

The period of instruction as decreed is,—for officers, 105 working days (4½ months), commencing usually at 8·30 A.M. For non-commissioned officers and sappers, about nine months, during which time, formed into squads of from 35 to 50 men, they are placed by the instructor in Field-works under the supervision of Royal Engineer officers.

Each squad is placed under one of two serjeant-majors and six "serjeant-instructors," specially

selected for their ability and knowledge of the subjects they are respectively to teach, each of whom, remaining with his squad during its whole course, is held responsible for its progress and good conduct on the works.

The subjects for instruction, both for officers and men, are classified as follows:—

1. Modelling in sand.
2. Spar-bridging.
3. Field-works of attack and defence.
4. Mining.
5. Floating Bridges.
6. Railways.
7. Sundry practices.
8. Projects.

To attempt to construct the whole of the works above enumerated on their full size would of course be an arduous task, requiring a vast, unreasonable expenditure of time and money, which, after all, would be unnecessary.

It has therefore been wisely resolved that the young officers and recruits shall construct works of great importance only on full scale, the rest on a reduced one of from either two or three inches to a foot, that is a quarter or one-sixth of their full size.

To effect the latter object, a supply of model gabions, fascines, sap-rollers, sand-bags, platforms, &c., have been collected for the use of officers and men who are required to fill, arrange, and otherwise use them with their own hands.

On entering the Royal Engineer modelling shed, which is about 120 feet long, 40 broad, and 15

high, I found executed by the hands of officers as well as of men, in moist sand, different models, on the scale above mentioned, of the identical works they are afterwards required to execute, on full scale, in the Brompton practising field.

Among them I observed the newly-designed "screen battery," so called because its front is screened by a detached parapet, containing openings corresponding in position with the embrasures of the real battery, the shot of which consequently pass both. The advantages of this battery, it may be briefly stated, are—

1. It conceals from the enemy the commencement of the construction of the real battery in its rear.

2. It intercepts a large portion of all shells fired nearly horizontally, thereby causing them to burst harmlessly in its parapet, instead of in that of the battery in its rear, full of men.

3. It prevents the enemy from seeing the exact position of the real battery, and as he is therefore ignorant of the intervening space, his fire, for want of an exact range, is made uncertain.

Batteries also of every description—elevated, sunken, half sunken—for guns or for mortars, with their various revetments, field powder magazines, also saps—standing and kneeling, single and double—the mode of crossing ditches, the construction of rifle-pits, &c., are here each and all modelled in sand.

When the Brobdignag inhabitants of this land of Lilliput have gone through a course of knotting and splicing, they are taught to construct, from hop-poles of suitable lengths and diameters, models of large spar bridges, triangular gyns, sheer-legs, &c.

Also how to put together, and afterwards take to pieces, certain lengths of model railway, the squads being moreover instructed in the best methods of platelaying, arranging crossings, switches, cross-over roads, &c.

Finally, both officers and men are, by models, instructed in the various modes of putting houses, enclosures, villages, &c., into a state of defence, including the making of abattis, breastworks, entanglements, and other obstructions.

FIELD-WORKS ON FULL SCALE.

On leaving the modelling-shed, I rode to the works actually under construction in the Brompton field; that is, a large plot of ground which had formed a portion of the glacis constructed during the revolutionary war for the defence of Chatham, with other fields purchased at the same time for the purpose of securing clear space for the fire of the guns of the fortress.

The town of New Brompton, however, which now lies just outside this Government property,

numbers about 10,000 inhabitants, with their streets, churches, &c., all of which, being far within rifle range of the ramparts, would evidently afford good cover, behind which an enemy might approach and commence his real attack at 400 or 500 yards, instead of at the much greater distance which the modern rifled artillery of the present day would otherwise force him to do.

For this reason, the lines formerly constructed for the defence for Chatham Dockyard being so near to the property they were designed to protect, that the rifled guns of an enemy passing over them could now seriously injure the dockyard, have evidently sunk into secondary importance.

So far therefore, as the old or *ci-devant* fortress of Chatham is concerned, this error, obvious at a glance to any one, is *une affaire finie*; but it may reasonably be hoped that, as regards the new works of defence constructed at Portsmouth, Plymouth, Portland, Dover, Pembroke, and elsewhere, the country will not, from a penny wise and pound *un*wise economy, allow buildings, &c., to be constructed immediately beyond them, to be used as counter-works of offence by an enemy, which military science, at enormous cost, had undertaken to repel.

Although the works of instruction in Brompton field are on full scale, yet, to avoid unnecessary labour and expense, and for a more irresistible reason,—from want of space,—I found them placed

closer to each other and to the fortress than they would be on actual service; and as any description of them in such a crowded, jumbled position would be incomprehensible to the general reader, I will endeavour to finish, or rather fill up, my slight sketch of the military method of approaching a fortress (*see* chapter headed 'The Model Room'), in which the following details were omitted.

Until the artillery fire of a besieged fortress is subdued and eventually silenced, the nearer works of attack cannot progress.

When the second parallel with the zigzag approaches, leading from the first parallel to it, with an adequate number of batteries for guns and mortars, have been constructed, other zigzag approaches, reeling first to one side and then to the other, like the progress of a drunken man, stagger forward towards the front, until they arrive rather more than half way between the second parallel and the advanced works of the fortress, where, by suddenly diverging to the right and left, in the arc of a circle of which the citadel is the centre, they form the third parallel, in which the guards of the trenches are assembled and concealed in sufficient numbers to protect the sappers, to whom, in the more advanced stages of the attack, is confided the special work of advancing towards the enemy by the regular process of '*sapping*,' from which they take their name.

So long as the trenches could be carried on by zigzags directed clear of the guns of the fortress, they were safe from being enfiladed (*i. e.* raked); but it must be equally clear that as they advanced, a point must eventually be reached at which these zigzags, if directed clear of the guns, without either advancing or receding, would, like the pendulum of a clock, vibrate backwards and forwards over the same line.

The only means, therefore, of further progress is by the "sap," in which the leading sapper, kneeling on the ground, and pushing in front of him a travelling parapet, in the form of a large, heavy, stuffed basket roller (called a sap roller), excavates a narrow, shallow ditch, or rather deep furrow, the earth from which he throws into a gabion, placed on one side of him, or on both sides of him, if he be exposed to the enemy's fire on either flank.*

A steel sap-shield, invented by Serjeant-Major Knight, R.E., consists of a steel plate of about the height of an ordinary gabion, resting on trucks, which enables the sapper, as he advances, to roll

* A young candidate for admission into the Royal Military Academy, on examination, replied to the Magnates as follows:—

Question 1.—What is a sap?

Answer.—A basket without top or bottom.

Question 2.—What is a sapper?

Answer.—A bigger basket.

Question 3.—What is a sap-roller?

Answer.—The man that rolls the basket.

it along the berm of the sap he is constructing, thereby protecting him from rifle-fire, until his gabion is filled, and his earthen parapet sufficiently thick to render his shield unnecessary. This invention is calculated to save much loss of life on service.

As the leading sapper advances he is followed by a second, who is followed by a third, who is followed by a fourth, each of whom consecutively deepens and widens the excavation, disposing of the earth from it like the first, until the said ditch assumes the title of a "trench," protected on one, or on both sides, by gabions now not only full of earth, but backed up by that superabundance of it which, when they had become full, had been thrown over them.

In this dangerous work the sappers are followed by parties of their gallant comrades, the infantry, who widen the trench sufficiently to allow of the passage of the requisite amount of troops, and of guns, intended for work still more advanced.

In this calm, steady, horizontal progress, however, the besiegers are sometimes forced to halt, from having ascertained that the intervening surface between them and their victim is what, although it be rather incorrectly termed *countermined*, means that it contains mines made and making, to blow them vertically into the air. It is necessary therefore to subdue the enemy under ground before proceeding to subdue him on the

surface, and accordingly now begins—out of the sight of every human being—not a battle, but a series of subterranean duels, in which more or less of the combatants, without metaphor, may be said to engage, not only shrouded in their grave-clothes, but in graves in which they are actually either to be shot or buried alive.

To engage in this strange contest the sappers, now abandoning that title and assuming their alias or other name of '*miners*,' directed by one or more Engineer officer, sink shafts, and, after descending by them, drive therefrom galleries, the object of which is to deposit and fire charges of powder sufficiently large to blow in the so-called *counter*-mines.

The defenders of the latter, in like manner, drive galleries to enable them to smother their advancing enemies by blowing in *their* mines. In this subterranean contest each party listens attentively to catch the sound of the enemy's pick, the blows of which can be distinctly heard through the solid ground at distances of from ninety to a hundred feet.

Instances have occurred of the two contending miners resolutely working towards each other, until the interval between them had become so narrow that a pistol bullet from the one gallery killed the miner in the other. The usual process, however, is to explode, at proper moments, a charge of, say, 1000 pounds of powder, which, by

bursting the enemy's galleries, buries him within them.

Each explosion, however, of this nature, by whichever party it may be effected, assists the progress of the besiegers by forming for them a crater, which, knowing that no mine can lurk beneath it, they immediately crown with gabion-parapets, forming a lodgement which they connect with their parallel in rear.

Among other dangers and difficulties which miners have to encounter in this dark warfare are want of ventilation, and the bad or asphixiating effects produced by the air in the mines becoming poisoned by their own or by their enemy's explosions.

The besiegers, thus slowly but surely advancing, both below ground and above, in due time reach the covert-way, situated nearly on the edge of the enemy's ditch; and as in a well-constructed fortress its escarp wall is so contrived as to be concealed from the view of all outsiders until they are close to it, the process of breaching has now to be commenced.

This process consists in making for the assailants what they term "a *practicable* road" up which, and over the bodies of dead comrades, they may at length be enabled to ascend to the main object of their labour; namely, to come face to face and hand to hand with the defenders, and thus conclude the business for which they came to the place.

This "practicable road," to be rudely and redly macadamised as described, it must be explained, is *commenced* by breaches in the escarp formed either by the fire of guns, or by mines.

If by the former, some of the trenches, made by sapping, have to be widened, and their parapets thickened, and so formed into batteries for heavy guns.

If by mining, means must previously be taken for silencing every gun the enemy may have kept intact for the defence of his ditch; and when this silence has been created, a blinded gallery is sunk in a sloping direction, so as to break out at the bottom of the ditch, which is crossed by a sapper, who is then, as it is termed, "*attached*" (an attachment somewhat similar to that of a bull-dog to the nose of a bull) to the escarp, which he commences first to bore, and then to undermine, for the purpose of depositing and duly tamping a charge of powder large enough to blow it down.

When by one or the other of these two processes, or by a mixture of both, the breach or breaches (for it is always desirable to have more than one point of attack, so that the defenders shall not concentrate all their resources against it on account of the besiegers having only one road to success) have been effected, and a practicable road into the fortress thereby effected, if the Governor of the fortress does not surrender, the

process of storming already described ends, as it did at Sebastopol (the total loss of the Allied army having been 10,018), "*the history of the siege.*"

And it must here be observed, that in this Cain-and-Abel contest between the two equally well-beloved sons of MILITARY SCIENCE, surnamed "*Defence*" and "*Attack*," each and both—the one positively, the other negatively—have demonstrated the truth of Vauban's simple definition that—

"*Fortification is the art of enabling a small body of men to resist, for a considerable time, the attack of a greater number.*"

The details of this "*art*"—as practised in Brompton field—I will now proceed to describe.

On entering it, in the first parallel, which, according to Vauban, should be 600 yards from the front attack, but which rifle-guns have now removed to a much greater distance, I saw before me a most important novel application of an old invention; namely, a small light "trench-railway," the startling name of which at once explains its utility.

When railways were first introduced into England, a considerable portion of Messrs. Pickford's goods suddenly, as if by word of command, travelled, or rather cantered, to their respective destinations, about ten times as fast as they had before been crawling in broad-wheeled waggons. But if this was the difference between their transit

on iron rails and on macadamised roads (which we had all of us been led almost to worship as the eighth wonder of the world), what, it may be asked, would be the difference to an army between not only all the food for its men's mouths, for its muskets' mouths, and for its cannons' mouths, but the enormous weight of the artillery and materials required by it for a siege, gliding to their respective destinations over iron rails, and wading through miry roads, rapidly converting into a Slough of Despond?

The above question has already been answered to the British public by the single word "BALACLAVA."

Now, to obliterate that word from future engineering proceedings, the "trench-railway" has been invented, or, as there is really nothing new in its principle, it would be more correct to say that the ordinary railway of the firm of Stephenson, Brunel, and Co., has been at Chatham adopted and *adapted* to the parallels and approaches of a siege.

The facility with which it can be so adapted has been demonstrated by the fact, that during last summer a squad of twenty-five sappers, who had been duly instructed in the work, with the assistance of twenty-five fatigue men, laid down 400 yards of line in the instruction trenches at Brompton in twenty-five minutes, so that the trollies or trucks for carrying guns, ammunition, &c., were able to pass along the iron road. The

materials had been previously prepared, and brought up, but the whole of the laying of sleepers and rails, and spiking down of the latter, were, it is alleged, done in the time mentioned. And very nearly at that rate, I myself saw the work proceed.

Military men, in one moment, will comprehend the advantage of this application of railways, and in order that civilians of all descriptions may comprehend it almost as quickly, I will simply state that in the official accounts of "Artillery operations in the siege of Sebastopol," it appears that, for the service of that noble branch of the English army, 1240 tons of gunpowder, and 936 tons of shells and shot, were expended. A considerable portion of the above, besides heavy artillery guns, mortars, ammunition, &c., were eventually brought up from Balaclava by railway, which not extending into the trenches, the guns were by men and animals brought into battery, across the open country, with the disadvantage that any one of them that stuck fast in the mud was unavoidably abandoned.

In the first attack of Sebastopol, 806 pieces of ordnance fired about fifteen millions of rounds, a "*feu d'enfer*," which, to use a milder expression, must certainly have rendered it to that distinguished engineer, Todleben, an infernal house to live in.

The trench-railway will in future of course enormously lessen at a siege the time, labour, and

consequently the expense, of bringing up from its Park, artillery, and all other requirements of war, especially if it could be connected with a permanent line of railway from the base of operations.

As, however, the narrow gauge is better adapted to the curves and turnings in the trenches than the broader one, the difference between them, unless it can be adjusted, must inevitably embarrass the traffic. Sidings will of course be required, particularly at the turns of the trenches, to allow trucks to pass each other.

In order to instruct the young officers and sapper recruits in the construction of the first parallel, a portion of which I saw before me, and in the subsequent zigzag approaches and works of a regular siege, after being sufficiently practised in making full sized gabions of brush-wood, and also of iron bands (as invented by Quartermaster Jones, R.E.), they were under their respective Serjeant-Instructors formed into squads for tracing parallels in daylight; and as soon as they were reported competent to do this, officers and men (the latter with tools) paraded at dusk, and proceeded in darkness to trace the first parallel and approaches with batteries and magazines complete, in accordance with a reconnoissance and report in writing previously required from one of the students.

These tracings are examined on the following morning by the Superintendent of Field-works,

attended by the young officers who laid them out.

When the art of tracing has been thus acquired, regular tasks, according to the nature of the soil, are given to parties of officers and men, who are kept at work occasionally throughout the night, their tools and stores being supplied as on service on the previous requisition of the young Royal Engineer officers who have been required to direct them.

In the course of instruction, different kinds of batteries and magazines are traced and built, their embrasures and revetments being formed with hides, gabions, fascines, sandbags, hurdles, and sods expressly prepared for the purpose.

By the officers and men, gun and mortar platforms of different patterns are laid.

Among the various works in progress which I witnessed were single and double saps.

The object of the above portion of instruction is to make the young Engineer officers and sappers competent to direct by night as well as by day working parties composed of officers and men of the line, who at a siege as a general rule work in the trenches eight hours consecutively; the Engineer working parties being relieved at different hours from those of the line, to enable the former, without the confusion which might arise from a simultaneous relief, continuously to superintend the working of the latter.

In rear of the second parallel I found on full scale "a screen-battery" of the latest and most improved construction. Within this battery, guarded in front by its screen (as already described), the men are protected by a series of narrow passages into which they can not only run for protection against shells, but which lead to subterranean bomb-proof magazines for both powder and shells.

In advance I saw constructed different descriptions of rifle-pits four feet deep, and usually about four and a half diameter at the top, and two feet six inches at the bottom, in each of which, during a siege, before sunrise, is deposited a soldier of the line, who in his lonely dwelling, isolated halfway between his defenders in the trenches and their enemy in their fortress, is kept alive by the fear which the latter have to rush out to exterminate him and his galling rifle-fire. Nevertheless, during the siege of Sebastopol, on occasions of "sortie" from the garrison, the English badger was several times bayoneted in his barrel by the Russian bears—his dead body, however, being quickly replaced by a living one, whose rifle, protected by a sand-bag, before sunset amply revenged his death.

Beyond a portion only of the third parallel I came to the locality in which the young officers and sappers, after having been instructed in the use of the hammer and jumper, and afterwards to load, tamp, and fire the holes they had formed,

proceeded to sink the shafts, and form the very galleries I have described.

In this subterranean duty, officers and men, divided into antagonistic squads, were required to go through a regular attack and defence by mines and countermines.

In these operations, which were conducted by reliefs of sapper-miners working against each other night and day, both officers and men practically experienced the difficulty of ventilating mines in consequence of the impossibility of making an opening from the galleries upwards to the external air, or of having return galleries as in coal-mines to carry away the noxious gases. Fresh air was therefore to be forced to the farther end where they were working. So insufficient, however, was the supply, that a young Engineer officer, and a non-commissioned officer, were nearly suffocated by the fumes of exploded gunpowder which, for want of ventilation, hung in the galleries of their opponents.

From similar causes the Prussian Engineers lately met with similar accidents.*

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* In the destruction of the docks at Sebastopol several men of the Royal Engineers lost their lives from the imperfect means available for ventilation, giving opportunities for the display of great gallantry, both on the part of officers and men, in going to look for their comrades who had become asphixiated in the mines underground.

At the siege practice operations at Brompton of this season, experiments were commenced with different appliances from what had previously been in use with a view to making mining operations less dangerous, by the supply of a larger amount of fresh air at the "dead of the mine," as it is technically termed.

In the Brompton siege operations I witnessed an experimental explosion of 1000 pounds of powder, which formed a crater 10 feet deep, and 48 feet in diameter at the top.

I also noted the result of a previous experiment in which, at a depth of sixteen feet below the surface, there had been deposited 1024 pounds of powder, surrounded at distances from thirty-two to forty-four feet by ordinary mining galleries at the same depth as the charge.

On the explosion of this charge by electricity, those galleries less than forty feet from the charge were nearly all destroyed; the others more or less injured.

For the purpose of instruction in blowing down stockades, I saw sixty pounds of powder attached by a sapper, by means of a gimlet, to a stockade covering the drawbridge of St. Mary's sallyport, composed of fir-timbers, averaging fourteen inches square, touching each other, with their ends firmly embedded in the ground, to the depth (I was told) of about four feet.

The effect of the explosion was a gap of five feet wide, through which troops almost immediately passed with ease.

I afterwards witnessed the commencement of a second cruel experiment on this stockade after it had been renewed by direction of General Simmons; and strengthened by heavy blocks of granite in one part, by a *banquette* of earth in

another, and by a series of larger timber trees laid almost horizontally with their butts upholding the timbers of the stockade in a third part.

The stockade was, moreover, partly shored up with railway bars and old guns.

On the explosion, by electricity, of a description of charge selected for this special purpose, severe dislocation and several small breaches were effected.

Adjoining to this stockade was a very ingenious one copied from the Chinese. When closed it exactly resembles an English one, but, as every third of its palisades is fixed on a pivot, the other two, by merely revolving, allow people to pass through, just as the bars of a Venetian blind, when drawn horizontally, admit the light, flies, or wasps, which when drawn vertically they exclude.

SPAR BRIDGING.

Across a chasm used for the purpose of instruction, the breadth of which can by the sappers be extended as may be required, officers and men, who have both previously been instructed in knotting and splicing ropes, and lashing spars, are here taught to construct with their own hands, simply of spars and ropes of various sizes, different descriptions of *land* bridges, suitable for the passage of heavy or light loads, such as trestle bridges, suspension bridges of rope or wire cables, timber railway bridges; and, lastly, field observatories,

the highest made by them this summer having been 170 feet.

Before proceeding to the construction of *water* bridges, as a preliminary precaution, all sappers are taught first to swim and then to row sufficiently well to pull and manage a boat from Chatham to Sheerness and back, with or against tide as it may happen, the whole distance being not less than twenty-five miles.

In addition to this horizontal movement on the *surface* of water, a certain number of Engineer officers and sappers, who have been pronounced fit by the surgeon, are sent down perpendicularly to the bottom of the river, in diving dresses,—

> "What dreadful noise of water in mine ears!
> What sights of ugly death within mine eyes!
> Methought I saw a thousand fearful wrecks;
> A thousand men, that fishes gnaw'd upon;
> Wedges of gold, great anchors, heaps of pearl,
> Inestimable stones, unvalued jewels,
> All scatter'd in the bottom of the sea,"—

to become competent, whenever required, to raise or blow up wrecks, or remove obstacles under water, and, accordingly, the iron steamship 'Foyle,' after having been submerged for many months in the Thames, thereby causing a serious obstruction, was completely broken up and removed by a diving party, consisting of the diver from Chatham Dockyard, an officer of Royal Engineers, and a party of diving sappers.

Finally, as regards water, *all* sappers and officers

are taught to sink wells, and especially to drive the American tubes, and thus, whenever an army, as in Abyssinia, is severely suffering from want of water lying in abundance beneath it, the sapper, as its wet-nurse, on being "sent for" can lull its cries by administering to it an immediate supply.

RAILWAYS.

In the Royal Engineer field-work course officers and men are instructed in laying and repairing a double line of railway, with full-sized rails, chairs, and sleepers of the ordinary description. They are also practised in the different methods of putting down crossing-points and switches, and of forming cross-over roads; the ballasting and drainage of the line being done by squads, and, *per contra*, they are taught how to destroy or render a railway useless to an enemy, by heating and then twisting its rails, &c.

SUNDRY PRACTICES

consist in learning to construct field kitchens, to throw hand-grenades, separately or in volleys, characteristically termed by the French army, when projected from a mortar, *bouquets*.

Men and officers are also practised in escalade drill, to bring up ladders, lower them down the counterscarp, carry them across the ditch, and then ascend the escarp.

In addition, they have lately been taught (this I witnessed (to escalade the escarp by means of grapnels, each about six pounds in weight, spliced to a one-inch whale-line.

A party thus supplied descends the counterscarp. When across the ditch the grapnels are hurled upwards to the berm, where they seldom fail to take hold. An officer and a few men then climb up the face of the wall. On reaching the berm, by means of other ropes thrown to them, they begin to haul up their comrades, and thus, by the aid of only four grapnels, a party of fifty men escaladed the works of Chatham lines, conjointly with an escalade by ladders, and in about the same time.

The grapnel however has this great advantage over the ladder, namely, that men, one by one, may approach with them without—as would be the case in carrying scaling-ladders—proclaiming their intention to assault.

In addition to the use of both scaling-ladders and grapnels, I saw Lieutenant H.R.H. Prince Arthur, heading a party of sappers, very zealously bring up, in double quick time, a flying bridge, which, on cleverly being pushed horizontally from the counterscarp to the berm at the top of the escarp, enabled first a body of infantry, and then a field gun, to cross the ditch 33 feet deep.

PROJECTS.

After the young officers, non-commissioned officers, and sappers have first attended lectures in the model-room, and, secondly, have on the Brompton glacis executed the field-works, &c., I have endeavoured to describe, the officers only, with a view to reduce, or rather to expand, the details of what they have been taught to practise, receive from the instructor a variety of written orders from which I selected as samples the three following :—

"*Royal Engineer Establishment,*
"*Chatham,* 1868.

"Mem. for Lieutenant ——, R. E.

"A column of cavalry, infantry, and 12-pounder Armstrong guns is to move across the river Medway at daybreak on the ——.

"You will proceed forthwith and examine the river between Wouldham and Snodland, and select the best site for the necessary bridge, and send in your project by 5 P.M. this day.

"The project must embrace a bridge-head, to be occupied by 1200 infantry.

"You will select favourable sites for any guns of position, that could be advantageously placed on this side the river, and provide for the working parties necessary to throw up any breast-works advisable for them.

"The working parties available are—

"8 military train waggons,

"5 companies of Royal Engineers,

"12 men of troop of Royal Engineer train,

"And any reasonable number of infantry.

"No opposition is expected in forming the bridge; but the enemy is reported to be moving in this direction.

(Signed) "Superintendent of Field-works."

"*Royal Engineer Establishment,*
"*Chatham,* 13*th June,* 1867.

"Mem. for Lieutenant ——, R. E.

"The enemy is reported to have effected a landing at Dover, and orders have been received for the troops at Chatham to fall back upon Woolwich, after destroying to the utmost of their power the railway communication, plant, &c. You will proceed forthwith and examine the line of railway between the Newington and the New Brompton stations, and send in a report by 5 P.M. this day, stating in detail the amount of damage that could be done to the railway, &c., in four hours from the time the troops left their barracks at Chatham.

"The troops, &c., available for the service are 3 companies of Royal Engineers,

"1200 Infantry,

"6 military train waggons,

"20 barrels of gunpowder.

"Detailed lists of tools, &c., required by you to be given in your report.

(Signed) "Superintendent of Field-works."

"*Royal Engineer Establishment,*
"*Chatham,* 186—.

"1.—Lieutenant ——, Royal Engineers, will prepare a Project for a military bridge of piles, to support 12-pounder

Armstrong guns, to be made of fir poles, 8″ diameter and length as required, over a river 100 yards wide and 6 feet deep, with tidal rise of 5 feet, banks and bottom of river of solid clay. Reports to describe how the poles would be driven, no boat being available. Pile-engine to be made on the spot. Monkey 13″ shell. Roadway to be covered with fascines, as no planks are available.

"2.—A general description of the proposed bridge, and of the method of constructing it, with an abstract estimate of the men, tools, materials, and time required for its formation.

"3.—A practical analysis of the data, showing the load to be borne, and its action upon the constituent parts of the bridge, the width of roadway required, &c., with a detailed examination into the powers of the parts of the bridge to resist the forces, &c., to which they will be subjected.

"4.—A detailed description of the arrangement and construction, and of the method of putting together and securing the parts of the bridge.

"5.—A detailed description of the subdivision of the work, and the organisation of the working parties, with separate estimates of the number of men and tools, of the quantity of materials, and the length of time required for each successive operation in forming the bridge.

"6.—A general plan, with the necessary sections and elevations of the bridge, accompanied by drawings on a larger scale of those details which cannot be clearly explained otherwise.

"The dates of beginning and ending the Project to be written on the plan and memoir.

(Signed) "Superintendent of Field-works."

As it was evident to me that, if a mass of orders of the above description were, merely as a matter

of routine, given to young officers without examining their reports thereon, by tacitly approving of errors, the instructor would do them a great deal more harm than good, I therefore requested to be permitted to see to what extent these reports (which, I observed, averaged nineteen pages of foolscap paper, half margin) had really been examined.

On overlooking them I found inscribed on them, in red ink, either by the superintendent or his assistant, remarks and criticisms, of which I copied into my note-book, *verbatim*, the following, as an average specimen of the precise amount of examination—neither more nor less—bestowed on these reports by the superintending officers.

1. "Your ramps are too steep; $\frac{1}{7}$ is the steepest that can be allowed."

This is not a safe assumption to make with rope lashings.

2. "These pontoon rafts should be placed in the middle of the bridge, and not at the beginning, as they do not, as barrel piers do, stand grounding on mud.

3. "Five barrels are too few for a pier, and 20 feet apart is too wide for the intervals between the boats, as they would have to bear 560 lbs. × 20 = 11,200, instead of 8000 lbs., the available buoyancy.

4. "The working load for a $3\frac{1}{2}$-inch rope is 11 cwt. 1 lb., therefore two ropes would not be enough to support your load, and, as your rope is

to be twisted (for the purpose of trussing up the bridge), an extra allowance should be made for unequal straining.

5. "This bridge will take a 20-pounder Armstrong gun, and also infantry in fours, marching at proper distance, and out of step, but it will *not* carry infantry in fours crowded."

Each young officer's report, signed by himself, having been examined and corrected in red ink, as above detailed, is taken by the superintendent to General Simmons, the Director-in-Chief, who himself examines the project,—when necessary calls upon the young officer for explanation, and when approved of signs it, to be further dealt with, as will be described.

PRINTING SCHOOL.

Many years ago I published a description of the interior of Clowes's great printing establishment, in which, in one compositor's hall, termed the "Quarter Deck," 200 feet long, I had found arrayed, in a sort of skirmishing order, sixty frames, in front of each of which stood in command thereof a compositor, delineated as follows:—

"On reaching their frames, their first operation is leisurely to take off and fold up their coats, tuck up their shirt-sleeves, put on their brown holland aprons, exchange their heavy walking-shoes for light brown easy slippers, and then unfolding their copy at once proceed to work."

In the *Imprimerie Nationale* of Paris, a description of which I afterwards published, the compositors were attired in still easier *deshabille*.

On pushing open the door of the "Printing School" of the Royal Engineer establishment (47 feet long, by 22 feet broad) there appeared, or rather flashed before my eyes, a line of compositors and pressmen, under the immediate charge of Serjeant-Instructor Adams, dressed in regimentals, with burnished buttons shining like gold, and, excepting that they had discarded their stocks, clean, upright, and ready, at the tap of a drum, to fall in for parade.

In short, I suddenly found myself apparently once again among transatlantic "red men," whose Manitou, or little devil, as he flitted about, reminded me of the schoolboy's line:—

"Trumpeter unus erat, cotum qui scarlet habebat;"

in fact, he really was neither more nor less than a "bugler."

Now, as it will no doubt—especially by the learned—be asked,

"WHY PRINT IN BUCKRAM?"

I will endeavour to answer that very reasonable question.

The reader has been made aware that the direct object of the great Duke of Wellington in creating a Royal Engineer establishment (see his letter to Lord Liverpool, p. 29) was to educate therein a

corps of sappers, competent, and at a moment's warning ready, to direct and execute siege operations.

General Sir Charles Pasley, who commenced the establishment, and the Directors, who one after another succeeded him, have however, successively taken a wider view, and accordingly it has gradually become, and it is now, a well-understood, a well-established, and a welcomed axiom in the corps of Royal Engineers, that, as regards both its officers and men, the word *education* means making themselves, by means of Science, in every way their ingenuity can invent, generally *useful* to any and every army in the field to which they may be attached.

But, in imposing upon themselves a long list of volunteer duties not required from them by the country, not ordered by the Queen's regulations, by the Minister at War, or by H.R.H. the Commander-in-Chief, they have clearly foreseen that in order to be "useful" it is absolutely necessary that the corps should also be "ornamental;" that is, that it should continue to be composed of highly disciplined, well set-up, smart soldiers; for otherwise, in endeavouring to be good at everything, they would inevitably, on active service, prove themselves to be good for nothing.

We all know that without discipline the finest of our regiments of the line become demoralised; but in the British service there are two large bodies of

men, namely, the Irish constabulary, 12,853, and the corps of Royal Engineers, 5032, who, for special reasons, require a higher description of discipline than is requisite for either cavalry or infantry, simply because instead of being congregated, they are continually liable to be detached, sometimes even singly, in lonely situations, subjected to temptations which undisciplined men would prove unable to resist.

The corps therefore has, I submit, wisely resolved that, even in their printing school, their goddess, Science, like the *vivandière* of the French army, must be required to wear uniform; and as the refreshments of the latter are not, to hungry or thirsty soldiers, rendered unpalatable by a pretty jacket surmounting loose scarlet trowsers, so do the corps of Royal Engineers practically find that discipline, instead of cramping, really helps, and never embarrasses, their multiform duties.

The printing establishment which I saw before me (attached to Colonel Wray's "course of construction"), and superintended by one serjeant-instructor, is composed, exclusive of volunteer students, of nine non-commissioned officers and sappers, and two buglers, all of whom, although in military uniform, were working as artists, as follows:—

4 compositors.
2 lithographers.
2 copperplate engravers.
1 letterpress printer.
2 assistants.

To enable them to labour in their respective vocations I saw in the hall—

3 lithographic presses.
1 letter press.
1 copperplate ditto.

The works they execute are pay-lists, numerous tabular forms, for the issue and receipt of stores, military reports, nominal rolls of men, an "architectural course," "notes on the practice of building," field fortification, notes of scientific lectures by civil engineers and others, illustrated by plans, sections, and drawings, a volume on electricity illustrated by 56 wood-cuts, a volume on military buildings, with numerous working plans in detail, notes on astronomy, tables of tangents, with various scientific projects and memoranda emanating from or submitted to the corps, all of which would occupy valuable time if circulated in manuscript, or cost money if printed elsewhere.

The saving however of money to the country is the secondary object of the establishment. Its primary one being to enable it to render assistance to an army in the field.

As it is of course of vital importance that the general orders of an army should be promptly distributed and readily understood, they are, whenever possible, issued either lithographed or in print.

It is therefore necessary to have a few instructed and practised compositors and printers with every army of magnitude.

Few people however consider how arduous and difficult are the duties which printers have to learn.

When one of our great orators, either in or out of Parliament, ejaculates a speech in its words two or three hundred yards long,* *his* labour ends with its last syllable.

The poor printer however, sentenced to revive the thing, has to crawl throughout its whole length—not word by word, as it was enthusiastically uttered; but letter by letter, from its beginning to its end—and then, instead of triumph, instead of "rest and be thankful," in order to replenish his cases for his next job, he has to perform the hard task of undoing and returning, or, as it is termed, "distributing," every single letter back again to the tiny cell from which he had abstracted it.

The above double work, in addition to lithography and copperplate engraving and printing, nine sappers at Brompton Barracks are now thoroughly competent to perform, and accordingly, at a moment's warning, they are ready to be despatched to any part of the globe to print for an

* In the 'Times' of the 22nd of October, 1868, the two consecutive speeches of our special orator occupied 6½ columns, each containing 231 lines, averaging 45 letters. Total number of letters ejaculated from one mouth, 67,567; length of lines in ordinary-sized type, 230 yards.

army by hand-presses, the practical utility of which would have been completely destroyed by an ambitious substitution of stronger but immoveable power, worked by steam.

Before however the Royal Engineer printing establishment can be of actual use in the field it will be necessary that letterpresses, type-cases, and a sufficient supply of type, should be arranged in a portable manner, so that they may be readily used during the intervals of an army's march, with the least possible delay, and this scientific arrangement is in progress.

It is to be hoped, therefore, that so important a precaution will not be lost sight of by our high military authorities, for truly it is bad economy which defers making requisite preparation for enabling the skill of the artizan to become available for service with an army in the field, until the emergency of war arises, when every department being in a hurry, there could be no time for testing the printing apparatus to be then provided, in which case it is more than probable that, notwithstanding the most provident care, some slight omission or defect would render the whole of it useless, or at any rate difficult to use.

I will venture to add, that the above observation may be applied to almost every special apparatus for scientific purposes, one perfect approved specimen of which should be kept in constant use in the schools of instruction at Brompton, as a pattern

upon which others could be made and multiplied for service in the field.

This system, which has already been wisely sanctioned in the formation of the A and B Troops of the Royal Engineer Train, as also for the telegraphic and signalling services (which remain to be described) ought, I submit, without further delay, to be extended (the cost would be trifling) to printing, photography, and any other cognate science which might practically assist an army in a campaign.

ROYAL ENGINEER TRAIN: B TROOP.

CAPTAIN LAMBERT, R.E.

England is indebted to Field Marshal Sir John Burgoyne for three valuable recommendations, proceeding not from his study, but while, in the 72nd year of his age, in his native element, he was under fire in the Crimea.

1. The introduction of Cavalry lasso-draught.

2. The construction and application of defensive torpedoes.

3. The establishment of a Royal Engineer Train (see his memorandum on this subject "Engineer Account of the Siege of Sebastopol," Part 1, page 149), which was organized on the following principles.

After mature consideration, it had been decided by our military authorities that the future structure of the British army for service in the field should be on a given scale of proportions:—

Taking "as an unit" an army corps of 10,000 Infantry in twelve battalions, with its proportion of Cavalry and Artillery, it was resolved, that the said corps should be organized in two divisions, each to be commanded by its own General; and it was further resolved, that there should be attached

to the whole corps three companies of Engineers, each composed of 1 captain, 2 subalterns, and 97 non-commissioned officers and sappers, thereby enabling one company to be detached to each of the two divisions, the 3rd remaining at head-quarters available for service with either, or as the General in chief command might decide.

In this building plan there was, however, an omission of almost as great importance as that of leaving out the staircase in a house, for while the infantry were provided with their tools, *i. e.* rifles, the cavalry with their tools, *i. e.* sabres or lances, the artillery with their tools, *i. e.* Armstrong guns, no adequate arrangement was devised for supplying the three companies of Engineers with *their* tools—namely, the surveying instruments, spades, shovels, pickaxes, &c., necessary for the defensive or offensive operations of an army.

In compliance, therefore, with Sir John Burgoyne's recommendations, the re-organization and details of equipment of a "Royal Engineer Train" were, by the War Department, under Lord de Grey, readily committed to Captain Duff, R.E., its present commander, who arranged them as follows:—

The whole train, composed of the necessary amount of men, horses, and materials, was divided into two troops, A and B, the former (as already described) forming a complete equipment of 100 yards of bridge, the latter (as will be described) forming a complete travelling equipment or store

of all Engineering instruments, tools, &c. required for actual service.

Each troop commanded by a second captain, with 3 subalterns, was subdivided into three sections, each under a lieutenant.

By this arrangement each division of the "unit" army of 10,000 men, &c. would be accompanied by an Engineer company complete, with a section carrying its tools and stores.

The important object, however, of this organization by Captain Duff is, that in the event of war, when probably either one or both of the single Troops A and B, would be found altogether insufficient, each of their six sections would form a well-drilled experienced *cadre*, nucleus, or "unit," competent by the addition of men, horses, and materials to expand itself into a pontoon troop, or into an equipment of the increased dimensions required for the campaign of a large army.

But, by the mere shewing of the case, it must surely be evident, that if from false economy the present Royal Engineer "unit" A and B Troops were to be deprived of their drilled horses and drivers, to be supplied with untrained ones in a hurry, in case of war, the whole preconcerted system of the War Office would break down, as surely as our artillery system would break down if in time of peace it were to be deprived of those gallant drivers, who, in spite of every description of fire, are eager to bring what they consider to

be "their" guns into action, and will die sooner than desert them.

For the benefit of the "unit" army the Engineer Train should also be enabled to maintain its efficiency by encouraging among its practised drivers the same useful *esprit de corps.*

The complete establishment of B Troop, divided as has been described into three sections, consists of 1 captain, 3 lieutenants, 1 assistant-surgeon, 1 veterinary-surgeon, 11 serjeants (two of whom I observed each wore two medals), 200 rank and file, including smiths, collar-makers, and wheelers—total, 215. 112 draught horses, 30 pack horses, with riding horses and officers' chargers, making a total of 145. 22 carts (2 horses each). 11 waggons (4 ditto).

I accompanied General Simmons on an inspection in the Brompton field of one section only of B Troop, the second being at work, the third in camp at Aldershot.

The section when drawn up in line, excepting the shape of its vehicles, and a row of horses that looked as if they were in armour, was a photograph on a reduced scale of that of A Troop.

There was the mute and motionless Engineer officer seated upright on his horse, with drawn sword, in full uniform, in front of vehicles guarded by sappers; there were drivers in the same uniform, the same accoutrements, the same short-legged,

short-backed horses, and the only differences were that the B Troop officer, instead of being a second captain, was Lieutenant Tisdall, R.E., and that as the A Troop horses, when I saw them at Wouldham, had been picketed in the open air, while the B Troop ones had just left warm stables, the coats of the latter were, of course, more glossy, and for the same reason, the steel and the chains of their harness sparkled in the sun as if they had been silver.

The section was composed of 7 carts, 2 waggons, 22 horses in draught, 3 spare pairs for ditto, 9 pack-horses laden with tools, and 1 spare ditto, 6 ridden by non-commissioned officers, 1 officer's charger—total 45.

The drivers, who, like the sappers, were dressed in scarlet, and who wore the black seal-skin busby of the corps, with light blue bag hanging over right side, plume on left, had suspended to white waist-belts long artillery sabres, in the exercise of which they are regularly drilled. The sappers were armed with the artillery breech-loading carbine, and as all the drivers and non-commissioned officers, as in A Troop, have lassos attached to the hide surcingles of their saddles, and are exercised to use them, the whole troop, or even one section of it, form a force capable not only of defending themselves, but if an opportunity offers, of capturing and carrying off any detached ill-protected vehicle of the enemy that may happen to stray within their sight.

The tip-carts, all covered with black painted canvas, were surrounded externally by a slight frame or ladder, on which the men's kits, the horses, forage, &c., can be lashed. As regards their *out*sides, they were of ordinary uninteresting appearance. Their *in*terior, however, contained food really fit for a philosopher to feast on, for instance:—

The store cart, a box of useful knowledge, contained a complete set of instruments for surveying and sketching ground, such as a 5-inch theodolite, 10-inch level, pocket sextant, 2 prismatic compasses, drawing instruments, boards, and paper, colour box, sketching cases, field-books, with a supply of stationery, and on service the official books and papers belonging to the section, and company of Royal Engineers.

When emptied of the above contents, by a clever sort of "Jack-in-a-box" contrivance, the sides and top of this tip-cart were suddenly raised, thus forming an "office," in which then sits, with a deal table before him, and shelves for his papers, &c., a non-commissioned officer, protected from sun, with curtains to shelter him from rain.

Two carts contained camp equipage for the company—18 circular tents, 120 blankets with waterproof covers, 10 camp kettles, &c., tools, 100 picks, 100 shovels, &c.

Two ditto, 100 picks, 100 shovels, 10 rammers.

Another cart carried camp equipage, blanketing,

and tents for the section itself, with its proportion of artificers tools, spare saddlery, and materials for their repair.

A forge cart contained a portable forge complete, a set of smith's tools, about 2 cwt. of iron of various description, and on service a small supply of coals.

Of the two waggons belonging to each section, one contained camp equipage for the horses, viz., blankets with waterproof covers, pads, and surcingles, picketing ropes, and picket posts, the horses themselves carrying their fetlock chains. The other, called the artificers' waggon, contained tools for bricklayers and masons, carpenters, collar-makers, painters, smiths, tin-smiths, and miners; also intrenching and cutting tools, lanthorns, short ladders, long saws, steel-yard, handspikes, and tarpaulins. Apparently with a desire to please everybody, there were also nails and screws for carpenters, leather and thread for collar-makers, candles, lamp-oil, powder-bags, fuze, powder-hose for miners, pick-points and steel for smiths, &c., making up a load of about 25 cwt. And as the waggon itself weighs 17 cwt., and the troop-stores packed around it about 5 cwt., its total weight rather exceeds 47 cwt., a heavy load for 4 horses, two of which carry on their backs a weight, living and dead, of about 11 stone, the other two from 2 to 3 stone. However, I must not refrain from asserting that these waggon horses are infinitely less

to be pitied than the poor creatures that are attached to the tip-carts, which, though still used in London and elsewhere for loads that require to be "tipped," are now being rapidly discarded by farmers, contractors, corn-dealers, coal-merchants, furniture movers, &c., many of whom have convinced me that a horse can draw, either on a level or up hill, in a light spring four-wheeled waggon, 30 cwt. with more ease than he can draw 20 cwt. in a cart.

On active service the former is the best, and the latter (excepting where "tipping" is required) the worst formation of vehicle that can be used.

In packing a cart for common traffic, no amount of science and care can prevent the load from mechanically almost crushing the back of its horse on going down a steep hill, or from diminishing his weight, and consequently paralyzing his power of draught, by almost lifting the poor thing off his legs in going up a precipitous hill.

But on service, if the cart, in a moment of alarm, is packed in a hurry, or if, at leisure, by sappers whose mouths happen at the instant to smell slightly of rum, the result is, that the animal starts either depressed or elevated by his load, even on level ground. For the sake of the poor horses, for the sake of the service, and on behalf of the drivers, who all unite in condemning the present vehicle, I therefore venture to recommend that light serviceable four-wheeled spring waggons should, without

delay, supersede in the Royal Engineer Train the present tip-carts.

PACK HORSES.

The object of the waggons and carts, fitted as above described, is to enable the Royal Engineer train, either in whole or in sections, to accompany a manœuvring army with instruments, tools, and implements with which to ply the art of war.

But as railway trains require rails, so do carriages of all descriptions require roads to travel on.

In order, therefore, to enable the train to continue to carry for the army a supply of tools, &c., in localities where either there are no roads, or only bridle-paths, Captain Duff, R.E., cleverly devised and organized a "pack-horse system," which I certainly inspected with great interest.

In the section before me, I saw standing as on a line of march, one behind the other, nine—not hogs in armour—but horses, some of which looked as if they had just been iron-plated and spiked in one of our dockyards.

On an ordinary pack-saddle, upon which had been placed a leathern rack, devised by Lieutenant Haig, of the Royal Engineer Train (now equerry to Captain H.R.H. the Duke of Edinburgh), were arranged as closely and as ingeniously as swords, bayonets, pistols, &c. in a show-armoury, a variety of engineering tools (the whole protected from rain

or pilfering by a water-proof canvas cover) such as axes, billhooks, crowbars, gimlets, and spike-nails, &c., total weight 17 stone; with this advantage, that the instant the horse halted in his progress, the moveable rack with its contents, could be lifted upwards and then deposited on the ground, and thus, by relieving the poor animal of its weight, prevent his back from becoming sore.

On another horse I saw farriers', smiths', and collar-makers' tools and materials, with 7 lbs. of iron and 28 of coal—total weight, 18 stone 6 lbs.

Three horses carried each 10 picks, 10 shovels, 2 spades, a tracing tape and line for laying out the position of trenches and batteries—total weight, 16 stone 7 lbs.

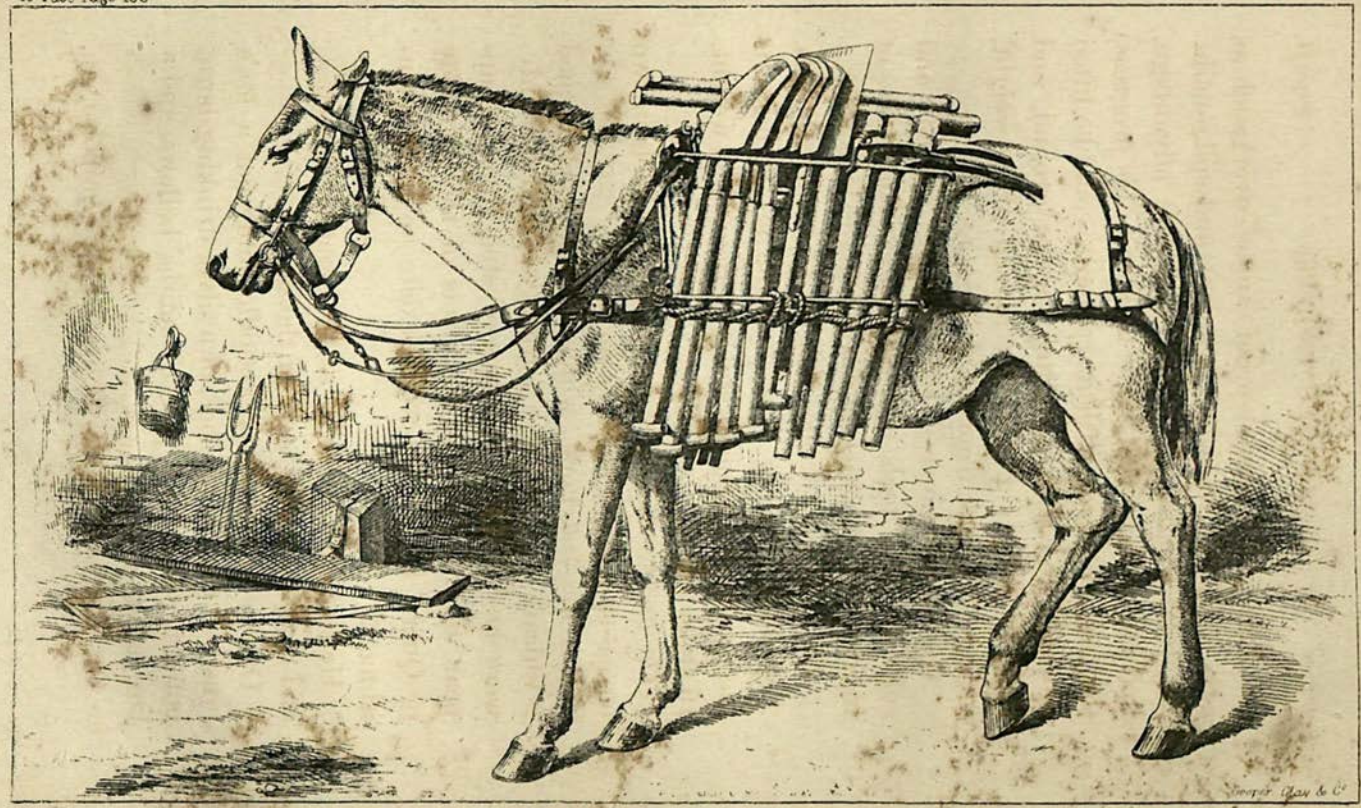
On another horse, a set of miners' tools in two boxes—total weight, 17 stone 12 lbs.

But the last horse, which I silently christened "Vulcan," was really a curiosity!—and certainly, were he led by a well-dressed stud-groom to appear at one of the crack meets of the Pytchley or Quorn hounds, he would excite no little astonishment.

He had been selected as the stoutest, strongest, and most muscular horse of the section.

On one side of his pack-saddle, hung not a fox's brush, a spare horse-shoe, or a silver drinking-horn, but a fire-hearth, a pair of smiths' bellows, and a box full of pokers, tongs, &c.

On the other side hung, as an equipoise, an



ROYAL ENGINEER TRAIN. PACK-SADDLE EQUIPMENT. INTRENCHING TOOLS.

London John Murray Albemarle Street.

anvil, its block, and a 7-lb. sledge-hammer—total weight, 280 lbs., just 20 stone.

Now Sir Sibbald Scott, Bart., in his history entitled 'The *British Army: its Origin, Progress, and Equipment*,' states—

"The troop-horses of the Life Guards carry 22 st. 9 lbs. 14 oz. —equal 317 lbs. 14 oz.—viz.:—

			st.	lb.	oz.
"Horse appointments, including cloak			6	11	8
Accoutrements,—	lb.	oz.			
Helmet	3	7			
Cuirasse	10	12			
Clothing	—	—			
			3	2	15
Average weight of trooper			12	9	7
			22	9	14"

Now if "Vulcan's" load and that of one of these noble-hearted Life Guardsmen's horses were to be accurately weighed the one against the other, not in the judgment-scale of the latter but in that of "Vulcan," I believe he would declare—

1. That while he would feel proud and pleased to carry the heavier weight (*i.e.* the living, elegant, easy-riding Life Guardsman) his back would almost break, even in trotting, under his own lighter but dead load.

2. *Per contra*, that in a charge his dead weight (that is his anvil, fire-hearth, bellows, sledge-hammer, &c.) would on collision enable him to knock the heavier easy-riding living weight, man and horse, head over heels.

"It must be so, Vulcan, thou reason'st well!" and for the following reason:—

When two discontented rams of equal weight, retiring from each other about the regular old-fashioned duelling distance (12 paces), and after frowning at each other for many seconds, all of a sudden rush forwards to "butt" their hard heads together; the result, in favour of the one or the other, is *nil*.

And, provided they were strong enough to bear the conflict, the same comparative result would occur, if two angry naval iron-headed steam rams of equal weight were in like manner at full speed to butt each other in the middle of the blue surface of the Atlantic ocean.

But if a steam ram and a steam ship, carrying also masts, yards, sails, and rigging, each of a total weight of say 5000 tons, were to butt each other on the same spot, the weight aloft of the ship being elastic, while that of the solid ram was inelastic, the result would inevitably be that the former would begin to sink, and the latter continue to float; but

"Tarry a little, there is something yet;"

I believe that "Vulcan," after having established the foregoing premises, standing firmly on his four stout legs, would expound to mankind that cavalry horses should be *strong*, heavy, well-bred, and well-fed; cavalry men, light. That, in time of peace,

the latter, when mounted on their strong horses, should term themselves "*light*" cavalry, and that after a declaration of war, and previous to a "glorious charge," they should, by their own mere motion, convert themselves into "*heavy*" cavalry by loading their saddles, like Newmarket jockeys, with the requisite amount of neatly-packed lead (not anvils, fire-hearths, pokers, tongs, bellows, &c.). Of course, if they were to do so, on collision with light cavalry, or even with heavy cavalry of their own gross weight, they would (that is the lead they carried would) knock their adversaries head over heels.

And thus, according to "*Vulcan's*" practical view of the case, if two equally handsome, say French heavy cavalry officers, of precisely the same weight as regarded both horses and riders, were at a tournament in presence of "the Queen of Beauty" and the fairest ladies of the land to tilt at each other at full speed, the one that *sat* on his cuirass, closely strapped by a surcingle to his saddle, would inevitably overthrow his easy-riding antagonist, who wore it gracefully on his breast and back.

In short, as in mechanics a blow of a hammer drives a nail into an oak plank easier than much pressure, so in collision weight in motion acts more powerfully dead than living.

VULCAN FAREWELL!

In the Royal Engineer Train not only are drivers as well as sappers taught to quickly load and unload saddles packed in the manner described, but what is also important, the pack-horses are broken in to march steadily under the said loads, many of which sometimes clatter and rattle very discordantly.

Of course their dead weight would make it difficult, without giving sore backs, to carry them for a length of time; but the great advantage of Captain Duff's arrangement is, that on any emergency it imparts to the train the power of transporting, for a short distance and by repeated journeys, tools, &c., sufficient to enable a force occupying a point which waggons and carts are unable to reach, either to protect itself by field-works or to destroy works of the enemy.

After inspecting minutely the whole section, and reflecting on the intricate and important duties which its sole officer—a young lieutenant of Engineers of only four years' standing—who, although brought up by three educations to what is called "engineering," and also instructed in the command of men, could not possibly have acquired much, if any, knowledge of the management of horses, drivers, and harness, of the packing and unpacking of carts, waggons, and pack-horses, and of the command of a large amount of valuable stores—I asked General Simmons, the Director of the Royal Engineer Establishment, whether the

other two young officers had shown themselves equally competent to command a section of the train. His reply to me (I copy it from my note-book *verbatim*, without the addition, subtraction, or alteration of a single word) was,—

"Each of those young officers has, in addition, to superintend the instruction of some of his men in musketry, of others, in sword exercise; he has also, by superintending the riding drill, to act directly as his own riding master.

"More than once, one of the subalterns of this B Troop has been detached alone, with his section for a year, with all this charge, and with these varied duties and responsibilities; without any other officer to assist him; so that he has been unable to get leave for more than 24 hours, and without a murmur, and to the entire satisfaction of the general officers under whom they have served, and of the officers of other services who have inspected them.

"During their detachment—say to the Curragh in Ireland, or any hunting quarter—these young officers have been their own paymasters, their own quartermasters, and yet, though exposed to all temptations, they have stuck to their duties."

Now as the avowed object and purpose of my brief visit to the Royal Engineer Establishment at Chatham, and of this volume, is to enable the public to judge for themselves whether the study of modern science—civil as well as military, to which all the young officers of Engineers are subjected—does or does not incapacitate them from the performance of an equal, or even a larger amount of regimental duties than is required from the

subalterns of all other branches of the British army, I submit for the attentive consideration it deserves, the following table, showing the actual numbers in the different branches of the service, as extracted from the Annual Estimates of (1868-9) the present year. The officers are given exclusive of the general officers who are honorary colonels commandant of the various corps, and of the medical officers:—

	Officers.	Other ranks.	Horses.
Royal Horse Artillery (per brigade) ..	34	927	678
Household Cavalry (per regiment) ..	29	407	275
Cavalry of the Line „ „ ..	30	555	368
Royal Artillery (Field Brigade) ..	50	1487	762
„ „ (Garrison Brigade) ..	48	815	..
Royal Engineers (A and B troops) ..	10	474	307
„ „ (per company) ..	3	95	..
Military Train	83	1705	996
Infantry (Guards, 3 battalions)	100	2439	..
„ (Line, per battalion, at home)	36	670	..
„ (Line, ditto, about to proceed abroad)	42	884	..

The above table shows that there is in the

		Men.	Horses.
Royal Horse Artillery	1 officer to	27 and	20
Household Cavalry	„ „	14	9
Cavalry of the Line	„ „	19	12
Field Brigades of R.A.	„ „	30	15
Royal Engineer Train	„ „	47	30
Military Train	„ „	21	12
Garrison Brigades of R.A.	„ „	17	..
Companies of Royal Engineers ..	„ „	32	..
Infantry of the Line at home ..	„ „	19	..
Infantry of the Line about to proceed abroad	„ „	22	..

The final results of the above table show that while in the line at home there is one officer for 19 men, and in the Cavalry one officer for 19 men and 12 horses, in the Royal Engineer Train, also at home, each officer, in addition to a variety of scientific duties, which at any moment he is liable to be required to execute, has on the average to take charge of 47 men, 30 horses, 7 carts, and 2 waggon-loads of valuable stores.

Now I submit that the solution of this apparently inexplicable comparison is simply as follows :—

It is unjust to the subaltern of the line, and unnecessary to the subaltern of Engineers to institute between them an invidious comparison which really should be made not between two individuals possibly brothers, but between two antagonistic national systems—the one scientific, the other unscientific.

Under the one system, the mind not only of the young officer, but the minds of all his non-commissioned officers and men, are

1st, instructed in all sorts of mechanical contrivances, and

2ndly, are required and encouraged to execute for the benefit of the army all descriptions of work, in all weathers, and under all circumstances, *with their own hands.*

The other system I at present decline to describe.

The inevitable result of the one system is that the subaltern of a single section of Royal Engineer Train A or B Troop is in fact a young general, having under him in his non-commissioned officers, and even in his men, an intelligent, well-educated staff, thoroughly competent to execute scientifically, either in his presence or in lonely detached localities, his orders and his wishes. Under this reasonable system, the sapper, laying aside his theodolite, throws off his coat, and (in obedience to orders) readily helps the driver to clean his horses and harness. In like manner, the drivers of the four leading horses of Pontoon A Troop, and also of those of B Troop, at the word of command, unhook, and having, purposely, breeching to their harness, and a joint in their long traces, at once harness themselves to carts.

Again, drivers, non-commissioned officers—several decorated—and even trumpeters, without prejudice, hook on their lassos, and for the benefit of the service work together the instant they are required, as drivers.

COURSE OF INSTRUCTION FOR OFFICERS AND NON-COMMISSIONED OFFICERS IN THE CONSTRUCTION OF CIVIL AND MILITARY BUILDINGS OF ALL DESCRIPTIONS, BRIDGES, RESERVOIRS, RAILWAY CONSTRUCTION, WATER SUPPLIES, SEWERAGE, &c.

LIEUTENANT-COLONEL WRAY, R.E., Instructor.
CAPTAIN SEDDON, R.E., Assistant-Instructor.

OFFICERS.

The duration of the above important course, which all officers of Engineers are required to go through, is 140 days, exclusive of forty additional days for what is termed "the long tour." It is divided into four parts, of which I can venture only to give the following meagre outline:—

The first part of the above course of instruction consists of lectures by the Instructor, on the application of theory to practice in construction, illustrated by a series of examples 37 in number, on each of which every officer is required to make notes, supported by mathematical calculations, which, after being examined and corrected by the Instructor in red ink, are written out fair, again examined by the Instructor, signed by him, and then submitted by him to Major-General Simmons, the Director, for final examination; finally they are delivered to the writer as accredited, corrected, and authentic data for his own future guidance. I examined several of these "notes and examples"

by different officers. Those of Lieutenant Christie, R.E., covered 151 closely-written pages of foolscap paper.

The second part of this arduous course comprehends "lectures" on building materials, of the various qualities and qualifications, of which copious notes are made and examined.

The third part.—On finishing this theoretical commencement, the officers proceed, under the Assistant-Superintendent, Captain Seddon, to study the practical application of the knowledge they have acquired.

First.—By lectures explaining the precise nature of different building trades, such as excavators, bricklayers, masons, carpenters and joiners, plasterers, plumbers, smiths, painters and glaziers, and slaters.

Second.—By *models* and detailed drawings of buildings, which the young officers are required to measure up and estimate, making specifications with all the details for their construction.

To assist them in the above studies, the officers are supplied with printed copies of notes and extracts collected by Colonel Collinson, R.E. (the former Superintendent) "on the practice of building," and on "military buildings" of every class and description. And as an encouragement and assistance, each officer is presented by Her Majesty's Government with a costly and valuable series of 44 large copper-plate engravings (each 1 ft. 10 in.

by 2 ft. 6 in.) containing descriptions of the details of buildings, with numerous lithographs and printed tables, to be paid for by the officers, comprehending details of construction, most of which have been approved of by the War Office.

Part four.—Each officer is now required to make a design selected from a number of works of construction, such as barracks, bridges, &c., with a report, specification, and estimate. All of which, after having been examined and corrected in red ink by the Superintendent, are finally submitted to be passed by the Director.

After the above described solid foundation has been laid, as a superstructure thereon, the officers are required to make at appropriate seasons—

1st. *Short Tours*, to examine, describe, and under written instructions report on, the most important works in the neighbourhood, such as the Government Dockyard extension works, Portland cement works, Roman cement works, lime-burning works, hand-made, also machine-made bricks, &c., &c.

2nd. *Long Tours.*—With a view to complete the education of young engineer officers in civil and military construction, Her Majesty's Government very liberally and very sensibly pay the expenses annually of about fourteen of them, who, under the guidance and instruction of the Superintendent or his assistant, for 40 days visit and report on works of engineering interest in our great iron and coal districts, railway works, large bridges under pre-

sent construction; also those which in past years have been constructed by eminent civil engineers, such as the Menai Suspension, Britannia Tubular, and other works of importance. The essence of these reports and illustrations is extracted, and retained in the Superintendent's office for reference, information, and application.

It is important to add that in addition to the course of instruction by the Instructor and Assistant-Instructor as above described, and in addition to these long tours (during which the officers have the great advantage of becoming acquainted with our best-informed civil engineers, by whom they are invariably received with a generous welcome), every officer and non-commissioned officer under instruction is required to attend about twice a week throughout the autumn and winter of each year, a series of evening or afternoon lectures delivered by civil engineers and other scientific men, the cost of which Her Majesty's Government also liberally defray. These lectures, usually taken by a short-hand writer, and, as I have already described, printed by the non-commissioned officers and sappers at the Royal Engineer Printing School, are at prime cost offered to be sold, and what is more, are purchased by the officers and sappers of the corps.

The last lectures given during the spring of 1868, I observed were four by W. Cawthorne Unwin, Esq., C.E., on

Stress on Beams.
Continuous Web-girders.
Braced Girders.
Iron Roofs.

Two lectures by W. F. Barrett, Esq., on

The Acoustics of Buildings.

Although some lighter studies remain to be described, it had perhaps better be here stated that in passing through the arduous Survey Course, and Building or "Construction" Course, each of which requires about six months' hard study, every young officer's report, signed by himself, and corrected in red ink as has been described, is, together with the officer who made it, taken by the Superintendent to General Simmons, who himself more or less examines it, when necessary calls upon the officer for explanations, and when finally approved of, signs it.

On leaving the establishment, each officer proceeds to the Horse Guards, taking with him his plans and reports on all the projects in all the departments of the Royal Engineer Establishment during his twenty months' work therein. These are finally submitted to the Deputy-Adjutant-General, Royal Engineers, and, when bound up, are returned to the officer (red ink corrections and all) for his future reference.

The illustrated reports alone of Lieutenant Frazer, R.E., the present Assistant-Instructor in

Field-works, bound up in two thick volumes, I observed contained—

Vol. I.	.. ..	647
„ II.	.. ..	502
		1149 closely-covered folio pages.

In the Director's office I saw a beautiful specimen of penmanship, delineating about 80 square miles of the Isle of Skye, lakes, &c., by Lieutenant Jekyll, R.E., which, although undertaken for amusement during his study in the Survey Course, had required 200 hours to perform.

(The Officers' "Battery Book" contains the notes necessary for certain parts of the Field-work Instruction Course, viz., siege-works, works of defence, mining, bridging, railways, field-observatories, boring for water, diving, the use of hand-grenades, escalading, &c.)

SCHOOL FOR THE INSTRUCTION OF NON-COMMISSIONED OFFICERS IN BUILDING, MEASURING WORK AND PREPARING ESTIMATES.

In a large hall, in two divisions, I found intently employed in drawing coloured plans, sections, &c., under the special instruction of Serjeant-Instructor

Miall, R.E., by direction of Lieutenant-Colonel Wray,

2 Serjeants,		
3 Corporals,		
2 2nd Corporals,	}	of Sappers.
3 Lance ditto.		
Total 10		

all of whom had been selected from volunteers for this course, either as good tradesmen, or men of experience in superintending works. Previous to admission, all had been examined in arithmetic, including a thorough knowledge of cubing and squaring quantities with a view to ascertaining their competence for estimating and measuring up work.

Their course of study, under Serjeant-Instructor Miall, besides making copies of drawings of details of buildings, which they afterwards take away with them, is composed of innumerable items, comprehended under the head of Lectures, which I copied as follows:—"Iron and steel, building stone, timber, asphalte, bricks, limes and cements, colours and colouring, bricklayer's work, mason's work, joiner's work, carpenter's work, plumber's work, plasterer's work," &c.

As soon as the non-commissioned officers, by listening to the above lectures, of all of which they are required to take notes, have become thoroughly acquainted with a building in all its details, they proceed to take out the measurements and quanti-

ties, so as ultimately to arrive at the total cost of the building.

In their "tours" to cement and brick manufactories they are required to make notes, with sketches describing and illustrating all they have seen.

Lastly, under Captain Stotherd, they for a short term pass through a brief course of chemistry, where they learn the analysis of limes, cements, stones, paint, and other simple materials used in building.

And then after their progress has been reported, and they have been recommended as competent to the Commander-in-chief, a certificate is delivered to them under the hand and seal of the Director, in which their qualifications are fully recorded, and they are permitted to attain the object of their voluntary course of study, by being appointed foremen of works, under the War Department, where, by acting as junior clerks of works, they cause a great saving to the public.

I have reason to believe that a great number of Royal Engineer non-commissioned officers who have passed through this school, have been, and are, employed in this capacity with great success.

THE UPPER WORKSHOPS,

which I found all domiciled in a not very long yard, enclosed by a gate, included in Lieut.-Colonel

Wray's department, are directly under the charge of an executive officer, Lieutenant Fellowes, R.E., assisted by a military "foreman of works," who has the general superintendence of the separate trades, which announced themselves to me to be what is commonly called "up and doing," by a chorus of those discordant noises which usually proceed from the tools, bodies, and bones of

6 smiths,
18 carpenters,
5 painters, glaziers and plumbers,
6 masons and bricklayers.

I found the above men in each trade overlooked by a non-commissioned officer, all working hard in blue checked shirts, regimental trousers, cauterised from hip to ankle with a red-hot stripe.

Throughout my short visit to the Royal Engineer establishment, I observed that wherever I went, the bodies of all non-commissioned officers and sappers seemed to have

1st. What philosophers call "a cohesion of attraction" for scarlet uniform with its appendages.

2nd. A centrifugal disposition to get rid of their stocks; and really, when one considers that, in their studies, as a tourniquet, it cuts off nature's food from their brains, and also paralyzes the ease and gracefulness of their physical movements, it must surely be difficult for very wise people to explain why it should be continued.

No man with a tight stock round his windpipe

could conveniently shoot a snipe; no man apoplectically bandaged by it would willingly encounter a tiger. Why, then, it may be asked, should men-shooters, *i.e.*, our gallant soldiers, be obliged to wear it?

In our jails strangulation has lately been transferred from the outside to the inside. In like manner might it not gradually be alleviated in the army, by requiring soldiers only to sleep in stocks?

The artificers I saw at work execute, I ascertained, all the repairs of their own barracks, carry out a great portion of the work approved in the annual estimates connected with the Royal Engineer establishment, construct the requirements of the field telegraph and other departments, and for all experiments made by the establishment, such as telegraph drums, the new experimental pontoons of Clarkson's material (I observed one just completed by them marked with chalk to weigh 8 cwt. 1 qr. 7 lb.), smith's work for all the departments. They have, moreover, fitted up the field-telegraph waggons, and also have executed not quite all the repairs for the photographic cameras.

It is in these shops that all sapper recruits are examined and *tried* in the trades they respectively declare themselves to belong to.

In the vicinity of these shops all officers and a portion of the men of the Royal Engineers are instructed, by the Field-works Department, in laying down an ordinary permanent way of railway,

by fixing the sleepers, chairs, and rails, inserting crossings with switches, &c., for shunting, with the ordinary arrangements requisite for "cross-over" roads of railway. These operations are merely to explain the nature of the work, so that, although not perfect platelayers—an act which men can acquire only by long experience—the sappers may be able to make a temporary repair of a damaged railroad, and learn how, if necessary, to destroy it.

From the workshops I proceeded to the adjoining Barrack Parade to witness the following experiment which General Simmons, attended by 15 or 20 young officers, was personally directing.

That portion of a pontoon platform or roadway, which from being suspended between two anchored pontoons is called a "bay," had been put together on the parade, of the following dimensions :—

Breadth of way, 9 feet in the clear.

Length of way or bay, 15 feet.

Number of baulks or rafters upon which rested the chesses or plank-boards, 10.

Five of them on one side, for experiment, being made of elm, and five on the other of Honduras mahogany.

When the bay so constituted, resting on two transverse beams, 14 inches above the ground, was finally adjusted and secured, in order to test its

general strength, and at the same time to test the comparative strength between its two different descriptions of baulks or rafters, an Armstrong 40-pounder breech-loading gun, weighing with its carriage about 4 tons, by drag-ropes was slowly hauled over it by a party of sappers.

The gun appeared to enjoy the jolly trial infinitely more than the bridge, which nevertheless silently grinned and bore it.

In consequence of which, just as that cruel king, Nebuchadnezzar, in the plain of Dura, ordered the heat of his fiery furnace to be increased, General Simmons ordered his sappers to draw over the prostrate bay a 64-pounder breech-loader Armstrong gun, weighing with its carriage about 5 tons.

During the infliction of this heavy punishment, the young officers were so eager to note the deflection of the bridge, and the difference of deflection between the two separate portions of it, supported by 5 baulks of elm and 5 of mahogany, that several times I heard sharply vociferated from old mouths, as words not of stern command but of friendly admonition, "*Take care of your* TOES!"

So far as I was competent to judge, the baulks or rafters, though they deflected, or, in simpler terms, bent (those of mahogany bending more than the elm ones) appeared fully capable to sustain 5 tons; nevertheless, each of the chesses or planks, though it neither bent nor broke, one after another creaked piteously, as the fibres on its sur-

face were being crushed by the gun-wheels, which, like those of the car of Juggernaut, passed in succession mercilessly over all.

TELEGRAPHY — TORPEDOES — PHOTOGRAPHY — CHEMICAL SCHOOL — SIGNALLING BY FLAGS AND BY FLAME.

Captain STOTHERD, R.E., Instructor.
Lieut. ANDERSON, R.E., Assistant-Instructor.

THE ELECTRIC TELEGRAPH.

Telegraphy is the art of signalling by electricity, sight, sound, or otherwise.

If, on the firing of a pistol, or on the exclamation or explosion of the common sporting monosyllable "OFF!" the notification of an important event were, by order of Her Majesty to be despatched simultaneously by the five following agents or agencies, at the end of the first second it would have been conveyed by

	Yards.
1. *The post-man,* trudging at his accustomed rate of four miles an hour .. not quite	2
2. *The race-horse,* galloping at the rate of Eclipse (said to be one mile in a minute)	29$\frac{1}{3}$
3. *The report of a cannon* (at the ascertained rate of sound, *i.e.,* 1142 feet per second)	380$\frac{2}{3}$

	Yards.
4. *A cannon ball,* rushing at the highest velocity ever attained by a shot on leaving the muzzle of its gun, namely, 2200 feet (after which its rate is rapidly reduced by the resistance of the air) ..	733*
	Miles.
5. *The pulsation of electricity* .. .. .. (*i. e.,* about $7\frac{2}{3}$ times round the circumference of the globe in a second).	180,000†

"In peace, Love tunes the shepherd's reed;
In war, he mounts the warrior's steed."

In like manner, electricity, which, generally speaking, by its *patte de velours,* brings all nations into friendly communication; by its *patte de tigre,* whenever required, just as cheerfully assists them in tearing each other to pieces.

But, whatever be its mission, whether to promulgate a truth, or the other thing, there hangs hooked up in its head but one unrelenting notion of careering through space, at its utmost, that is, its only pace, without rest or refreshment.

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* The velocities of shot on leaving the muzzles of our present guns, for the first second only, are—

	Feet.
Rifled field guns	1200
Rifled heavy guns with battering charges	1350
68-pounder, 16 lbs. of powder	1579
32-pounder, 10 lbs. „ „	1690
24-pounder, 8 lbs. „ „	1720

† At the bottom of the Atlantic this pulsation, like old age, becoming feeble, sinks to only 6220 miles in a second. Nevertheless, at the dinner lately given to Cyrus Field in London, when the land and sea electric lines were connected sensationally between San Francisco in California and Willis's rooms, a message sent after sunset from the latter to the former was acknowledged in two minutes, it having overtaken and left the sun in California high in the heavens, crawling

"In its bright course to the Occident."

Nevertheless, although our philosophers have been unable to check the speed of this runaway wild horse of creation, they have managed to *Rarey*-fy him with such astonishing success, that not only can a message, like Mazeppa, be firmly attached to him, but by means of a slight wire they can guide him in any direction, be it straight, serpentine, circular, parallel to the course of common roads and railways, over a city from one stack of chimneys to another, through tunnels, across hills and dales, until at one prodigious souse, with scarcely time to wet himself, submerging the great Atlantic Ocean, from Heart's Content onward he speeds, until, having "completed" what lawyers term his "circuit," he reaches and reposes in his stable "*the earth.*"

"'Midst pleasures and palaces though we may roam,
Be it ever so humble, there's no place like home."

In the Crimean war the British Government caused a telegraphic line to be laid between Varna and the Monastery of St. Georgia, from which lines were laid to Lord Raglan's head-quarters, and thence to established stations in the trenches. And again in the Indian war, Lord Clyde's head-quarters were kept almost constantly in electrical communication with the head of the Government in Calcutta.

The recent American war also from 1861 to 1865 developed and demonstrated fully the immense advantages to be obtained by means of

electricity; but although a school of electricity had been established for many years previously at Chatham, it was not until the Prussians, in the campaign of 1866 in Germany, enlisting as a recruit this fleet-footed Mercury into the service of Mars, made use of a military field telegraph equipment—which, by keeping the head-quarters of their separate armies in communication with their base of operations, and with the Bureau from which Baron Von Moltke directed their movements to a combined action against the Austrian army before the battle of Sadowa, had thus contributed so very materially to the brilliant success of the seven days' campaign—that electricity was fully recognised as an important agent in all military operations in the field, and it was decided to establish a travelling equipment adapted for the instruction of the officers, non-commissioned officers, and sappers of the Royal Engineers, and at the same time to serve as a model unit, upon which, in the event of war, others might be organized.

On visiting the field electric telegraph establishment at Chatham, I found it composed of two travelling office waggons and two wire waggons for carrying a certain length of insulated telegraph wire with the necessary amount of stores.

With this preliminary equipment to work with, all engineer officers and a portion of the sappers are practised in the rapid construction of such tem-

THE ROYAL ENGINEER FIELD ELECTRIC TELEGRAPH TRAIN, WITH ITS STORE , OFFICE, AND ELECTRIC WIRE WAGON, &c.

London John Murray Albemarle Street.

porary lines of telegraph as would be required in keeping up the communication of an army in the field, or in connecting detached bodies of troops with their head-quarters, and *vice versâ*.

For the attainment of these important objects, the travelling office carries in a compact form and ready for immediate use, the telegraph instruments, batteries, &c., which in an ordinary line form the working plant of a telegraph station, so that whenever and wherever it halts, the officer, non-commissioned officer, or sapper in charge is in a position to transmit a message the instant the conducting wire is attached to the instrument and battery beneath his feet.

The travelling telegraph office—in which as a dealer in lightning wholesale and retail, I sat by myself for several minutes, ruminating whether I most resembled *Jupiter Tonans*, or a common itinerant wizard—is really a curiosity.

The sides and doors of this small chamber (4 ft. 3 in. in breadth, and 5 ft. 6 in. both in length and in height) are composed of cedar; its window being shaded by sliding green curtains.

The furniture consists of a desk covered with fine green cloth, on which stood before me two of Morse's recording instruments, each about the size of an ordinary drawing-room chimney-piece clock.

Beneath the desk, neatly arranged, and living together in happy communion, I discovered two electric batteries and two spare instruments.

My seat, a cushion resting on two light white wicker baskets, contained a set of day and night visual signalling apparatus, a light patrol tent, and a set of cooking utensils.

These wicker baskets, packed as above, and adapted to travel on a pack-saddle, enable the establishment, wherever the wire-waggon is unable to proceed, of a branch station for visual signalling.

On the left of the operator or magician, when seated on this cushion is a cupboard opening by two light thin sliding doors, containing coils of recording paper, with a signalling apparatus to enable him to communicate with the men he has detached with the baskets on pack-saddles; lastly, it contains their kits, accoutrements, and, when on the march, their provisions.

At the back of the seat are racks for the sappers' rifle carbines and sword bayonets; over the operator's head are fixed their tent-poles.

Outside, on the roof of this conjuror's den, high above the two horses that draw it, is a seat and cushion for three non-commissioned officers, with a large boot beneath to carry the horses' gear and driver's kit; and underneath this boot a compartment, extending the whole breadth of the carriage, containing a water-barrel, field-stove for soldering, &c., hammers, a spade, and a few other heavier tools. The whole on springs with a drag-chain.

To this little travelling office—which, weighing when fully loaded only about 20 cwt., is of course

easily drawn by two horses—are attached 3 non-commissioned officers, each competent to act as a telegraph clerk, and 1 driver.

The Wire-Waggon,

drawn by four capital short-legged, active horses, conducted by two drivers girded with swords, and protected by its armed guard of non-commissioned officers and sappers, is composed of the platform and wheels of an ordinary general service waggon, on which, as a superstructure, is an elevated driving-seat capable of carrying three men, having beneath their feet a deal box of the whole breadth of the waggon, about 2 ft. deep and 3 ft. broad, containing besides picks and shovels, the kits of the drivers and their provisions.

On the platform behind are fixed two sets, four in each, of revolving drums, around each of which is coiled half a mile of insulated telegraph wire (making altogether four miles).

Reposing between the two sets of drums lie 24 iron tubular poles 10 ft. long, of 1½ in. diameter, each of them containing within itself another smaller one 9 ft. long, which on being drawn out, can, by a common bayonet-socket arrangement, be firmly fixed to the larger tube, thus forming a pole of elevation 18 ft. high, which is fixed or inserted in a hole made in the ground by a common crow-bar, or "jumper," driven by a sledge-hammer, and

then like the pole of a tent maintained in its place by three wire-rope guys secured to pegs, similar to those of a tent, excepting that they are of iron instead of wood, to prevent hungry men burning them for cooking when short of wood.

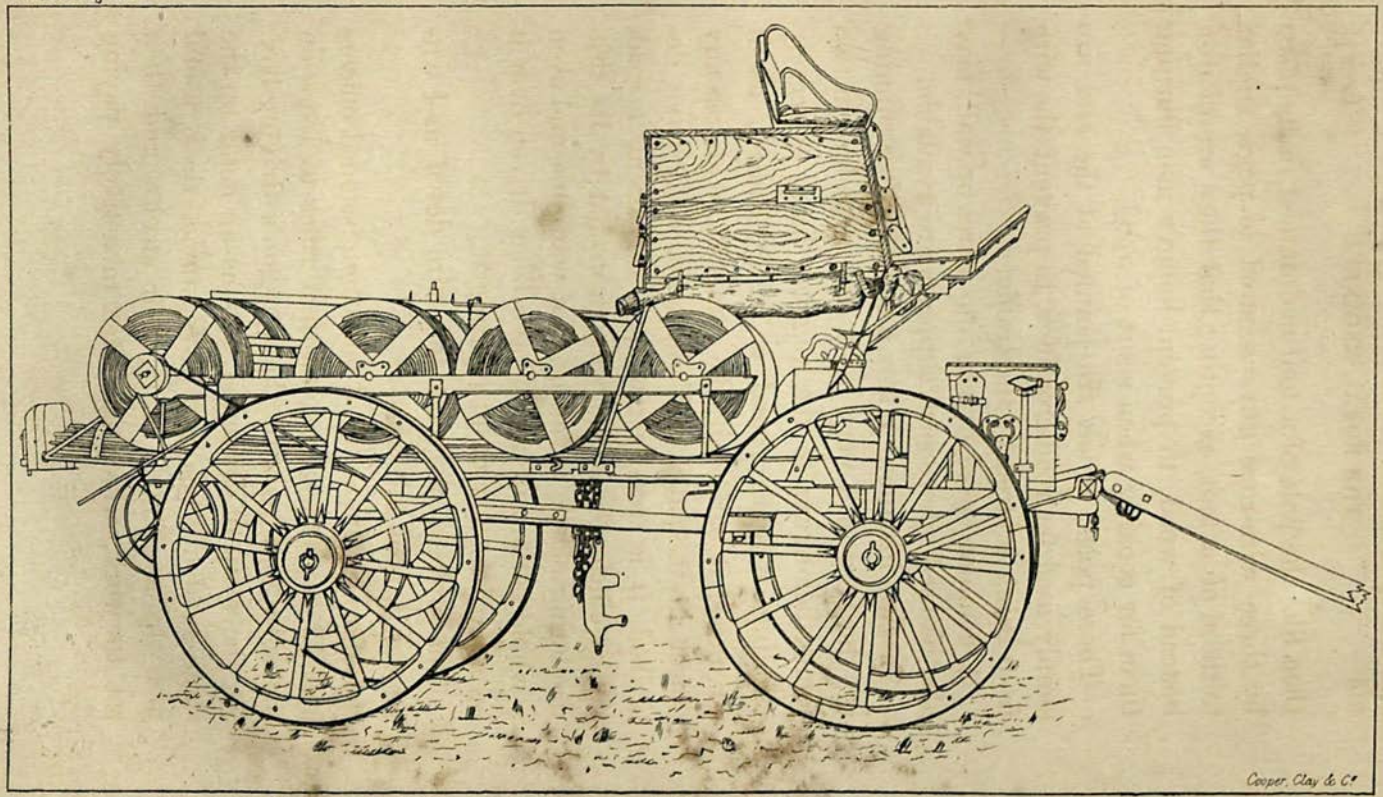
These poles, which are pointed at the end, are simply used for road-crossings, to prevent the wire from being injured by the traffic.

A common spike, driven into a tree or wall, may also be used where such supports are available.

In two instances I saw a sapper, after running up the bars of a very light scaling ladder in two joints, belonging to the waggon, fix it by merely winding it once round a tree. Indeed, as it advances, it can easily be attached to almost any object in its path, and although, as I have described, it is usually elevated on passing a road, yet so efficiently is the wire protected by its thin insulating elastic covering, that waggons, and even a whole battery of guns, have been driven over it on a hard road without injuring it.

The process of laying the wire down, as I witnessed it, is as follows :—

Before commencing, 3 non-commissioned officers and 12 sappers suspended their rifles to loops on the sides and rear of the waggon's driving-box. At the word of command, just as an actor on the stage suddenly changes his costume, these useful men threw off their coats, their stocks, and then set to work, which consisted in actively paying



THE WIRE-WAGON, CONVEYING ALSO TUBULAR POLES FOR ROAD-CROSSINGS.

London. John Murray, Albemarle Street.

out and fixing in the different ways I have described, the wire as the waggon proceeded.

As soon as one of the 8 half-mile coils was expended, I saw it rapidly connected with the wire of another by a simple and scientific joint (invented by Serjeant-Instructor Mathieson, R.E,) so thoroughly waterproof, that it is now used as a joint for connecting the electric cables of torpedoes under water.

To test the efficiency of the junction, I was permitted, or rather requested, to despatch a message from the itinerant wire-waggon to the Brompton Station, in reply to which an answer, (about equivalent in market value to my message), was very quickly returned.

In communicating by the ordinary needle telegraph instrument, it is deemed necessary to reply after each word that it is understood. By Morse's recording instrument with its tape, which flows on continuously, this is not necessary.

When the wire-waggon with its extraordinary conversational apparatus, from the absence of roads, or from the presence of bad ones, or of boggy ground, is unable any longer to proceed, one or more of the 8 half-mile coils are carried forward by sappers on a hand-truck, (it occurred to me that one of these coils might easily be affixed to a horse's pack-saddle), and uncoiled by other sappers as they proceed, the electric communication being maintained by a portable sounding, hand instru-

ment already described, ingeniously adapted by Captain Stotherd to be worked by one battery in the waggon, by which arrangement the electrical pulsations are communicated through the vein or wire from the arterial line, of which the waggon is the extremity.

As Professor Sir W. Thomson in one of his celebrated papers on electricity states that "electro-motive force is due to that part of a circuit where a '*degradation*' or consumption of energy takes place," it is to be hoped that Her Majesty's Government—seeing that in the present advancing state of military science an army manœuvred by electric information must inevitably wield an immense advantage over one whose every movement has to await written orders or "words of command"—will deem it proper, instead of "degradation," to give their "electro-motive force" to the strenuous efforts which the Royal Engineer Establishment at Chatham is making to perfect in time of peace a field telegraphic system, ready for immediate service, in case of war.

In the meanwhile, in Brompton Barracks, there exists an unceasing friendly antagonism between the instructors in "construction" and in electricity. The one teaches young officers how to construct bridges, docks, fortifications, and casemates; the other how, as at Sebastopol, Corfu, &c., not only to demolish them, but thereby to render it more difficult to root up old foundations, and restore a subverted

superstructure, than to excavate on a fresh spot and work with new materials.

CHEMICAL LABORATORY.

On entering the Laboratory, under charge of a non-commissioned officer of sappers, I found it, as might be expected, swarming alive with bottles of all sizes and colours.

All officers of Engineers, all non-commissioned officers who go through the school of instruction to qualify as foremen of works, and a small number of non-commissioned officers and sappers who volunteer, are here taught the simple analysis of limes and cements, paints, metals, and the principal stones used for building purposes.

The object of this instruction is to enable them to test the quality of materials supplied for Government purposes at foreign stations.

Its practical utility was exemplified a few days ago. A contractor having supplied the Government with some white paint, the non-commissioned officer whose duty was to receive it, by analysis discovered that instead of being composed of pure carbonate of lead, nearly one half was a mixture of lime and baryta.

The result was that the next quantity sent proved to be the pure article.

The analysis of water, especially to ascertain the presence or rather absence of organic matter,

though easily learnt by the sappers, is, of course, highly important for the health of troops.

THE PHOTOGRAPHIC SCHOOL.

Although the well-known process, or rather results of photography, have for many years been employed by officers of Engineers employed in the Ordnance Survey of Great Britain, and on other works, yet it was, I believe, used on active service for the first time in America by the Federal force, who in their late war attached to their army a travelling photographic military equipment, consisting of a black hole, or dark room, in the form of a two-wheeled cart, carrying all the necessary stores, camera, &c.

The value of this equipment will be best explained by the following extract of a Report from the Chief Engineer of the United States, General Richard Delafield, to the Secretary at War, for the year ending 30th June, 1868:—

"Accurate maps and topographical information of the country to be passed over were much needed and called for the earliest attention of the engineers. . . . . .

"Every road within the lines of the army was examined and surveyed, and the work pushed as far to the front and on the flanks as practicable. Their notes were at once photographed in the field, and distributed for use. Revised editions of these photographs were published as fast as any new information was procured. In this way several editions of eleven maps were arranged and issued, comprising surveys covering an area of 730 square miles.

" . . . . . More than 1200 maps were issued previous to crossing the Rapidan, and over 1600 photographic sketches between that date and the 30th July, 1864."

Profiting by the experience thus gained by the United States, Her Majesty's Government authorised the fitting up at the Royal Engineer Establishment at Chatham of a complete photographic equipment for service in the Abyssinia war, adapted for transport on the backs of mules, to be worked by trained non-commissioned officers of the Royal Engineers, for the purpose of copying and reducing to an uniform scale the various plans and sketches of roads and positions made by officers on the staff of the army, and reproducing them in such numbers as might be required to guide the movements of troops.

Copies of these plans, showing the positions of the various camps and of the troops along the road from the Red Sea to Magdala, were sent home by Lord Napier from time to time for the information of the Government, by which, at a glance, they were enabled to discern much more clearly than any written description could convey the precise position of each brigade, regiment, or detachment, as it was bivouacked or encamped on the particular day on which the despatch referring to its enclosed photographic print was sent off.

The men who were attached to this portable military photographic equipment, and who belonged to the 10th Company of Sappers, under the

command of Major, now Lieut.-Colonel Pritchard, R.E., accompanied the head-quarters of Lord Napier's army throughout the expedition to the point of its furthest progress, and were present at the fall of Magdala. (For an important reason, which will subsequently be explained, the reader is requested to bear the above statement in mind.)

Again, photography has been applied to record the precise state of fences and buildings in the vicinity of the new forts which of late years have been erected at the great arsenals at Portsmouth, Plymouth, &c., on lands acquired by Government by a money payment for what are called "clearance rights," including the right to prevent anything more substantial than at present exists being erected, and especially any walls or buildings which would obstruct the fire of guns. By a photographic view is preserved a faithful record which would probably be accepted in a court of law.

By this means also any experimental field-works, in the construction of which particular ingenuity had been shown by officers or sappers, such, for instance, as spar-bridges and field observatories, had, I remarked, previous to demolition, been photographed for future instruction to officers at home and abroad.

At Dover, in Chatham Dockyard, and other places, photographs have been taken periodically by the sappers, recording, for the information of the heads of departments in London, under whom the

works, including barracks, are being executed, their progress up to a given date, thereby saving to a great extent the expense and trouble of making for them progress plans.

Photographs have in like manner been taken by Royal Engineer officers and sappers, showing the effects of the explosion of recorded amounts of powder in the demolition of the fortifications of Corfu and other places.

Photographs by sappers employed by "The Palestine Exploration Fund" and others, have been taken of antiquities of Greece and Palestine; also of views in Central America, for the purpose of enabling projectors to determine the best position for a proposed line of Atlantic and Pacific Railway.

In India three non-commissioned officers and sappers were sent from the school at Chatham to photograph the appearance of the recent eclipse of the sun.

Accompanying the head-quarters of Sir Robert Napier's army, the sappers, besides photographing maps and plans as described, took views of all the most striking features of the country, also portraits of the most noted of the natives—such as the Queen of the Gallas, Theodore's son, Prince Kassa, of several European and native regiments in camp, also an exact record of the different sorts of pack-saddles rejected as well as adopted, &c., &c.

In this school the Royal Engineer officers and men are taught also the photolithographic process,

by which copies of drawings of all descriptions may be transferred to the stone, and produced at a rate infinitely quicker and cheaper than by plain photography, or by ordinary lithophotography.

By this clever process the sketches illustrating the descriptions in this volume, in compliance with my request, were 1st, photographed by Serjeant-Instructor Church, R.E., in about 4 minutes; and 2nd, transferred very quickly by Serjeant-Instructor Adams, to stones from which impressions have been taken by my printer with the same rapidity as the letter-press.

The foregoing rough outline of the value of the Royal Engineer's Photographic School, which by study, reflection, and unremitting attention is now steadily progressing, will, I trust, satisfy Her Majesty's Government and the public that it is worthy of cordial encouragement and support.

SIGNALLING,

BY SIGHT AND BY SOUND.

"*Cab, ma'am?*" "*Any luggage, sir?*" says another sixpence-seeking porter, as by one turn of his wrist he opens and, walking slower and slower, holds ajar the door of the arriving express train until its dying locomotive power has gradually expired on its rails.

"*Four-wheeler!*" says an excellent bishop, dissenting from the inviting nod and up-raised whip of a "Hansom" driver. "*Here ye are!*" exclaims the four-wheeler.

In a few seconds, from the doors of a long line of carriages are seen stepping out, rolling out, hurrying out, and here and there almost tumbling out, a street load of 2nd and 3rd class passengers of all sizes, all colours, and all ages.

Before them, not in array, but in the shapeless form termed "higgledy-piggledy," stand a crowd of men, women, and children, who for a short period have been awaiting their arrival.

Ere five minutes have elapsed, a wonderful amount of important business has been transacted; mothers, aunts, grown-up sisters, each snatching off the ground a child, has kissed it till its little legs began to struggle—several more elderly people have endured the operation apparently without struggling at all—a number of right hands have violently shaken other ones—people more or less bending their necks and stooping their heads have entered, and then half revolving, have ensconced themselves in private carriages, cabs, 'busses, which, laden with multiform luggage, have nearly altogether driven out of the large entrance gate, until, in a brief space of time, the station-master and a few porters are once again left the almost lonely sentinels of the post.

The express-train passengers have all passed to

their long or their short homes, and yet, alas! it is but too often the real truth, that not one of the multitude—including even he in the four-wheeler—before leaving the terminus, paused for a single moment to thank Divine, or even human, power for having, along the summits of embankments, between steep cuttings, across plains, or through long dark tunnels, in spite of rain, wind, or fog, enabled them to travel for hours at a speed sometimes equal, or nearly equal, to double that of the fleetest race-horse, without the smallest injury!

In like manner, people, however intelligent they may be on general subjects, are very apt, apparently by universal consent, to neglect to inform themselves of wonders that are almost every day passing before their eyes.

For instance, everybody now-a-days receives or despatches a message by electric telegraph.

At any small station the sender may be seen overlooking the shoulders of a sharp boy, whose wrists, by sudden convulsions, are despatching a series of words repeated to him, as if from another world, by a little active black hand, or rather finger, that appears by its movements to belong either to some imp of darkness, who has no mind at all, or if he has one, who is everlastingly changing it. In fact, the black finger the instant it ceases to be tremulous, falls into convulsions of unequal durations.

Now, I believe, it may be said that of our

community who, more or less, all understand and appreciate the value and the miraculous speed of the electric telegraph, not one in a hundred thousand has ever cared to learn how the message he sends or receives is communicated, and that the wise exceptional one, however amply he may have studied the subject, has never proceeded to consider whether the manipulation exerted by the electric-instrument boy could be applied to any other purpose of general utility. But like the man who first picked up in California that tell-tale nugget of gold which, through ages, first of intellectual darkness and then of daylight, had lain on the surface of the earth disregarded, Major Bolton, late of the 12th Regiment, with his colleague, Captain Colomb, R.N., late flag-lieutenant to Rear-Admiral Sir Thomas Pasley, Bart., in the year 1861, picked up, or rather picked out of the hands of the electric-telegraph boy a ready power for enabling ships, armies, forces, and even persons of every description, to communicate with each other by visual signals—that is to say, in daylight by revolving shutters, collapsing cones, flags, banderols, jets of steam : in darkness by lamps or lights; moreover by sound, that is to say, by a fog-horn, bugle, steam whistle, the whole forming what, although easier expressed than understood, is now called "*the flashing system.*"

Now the reader who from the foregoing lengthy

exordium, may very reasonably expect that he is about to be persecuted by an equally abstruse, intricate, wearisome explanation or muddification of a very difficult problem, will, I believe, be greatly relieved when he learns that the convulsive movements by which the announcement of, say the birth of a princess, flies along the electric wire, or is communicated by revolving shutters, collapsing cones, flags, banderols, jets of steam, lamps, fog-horns, bugles, or steam whistles, are in every single instance composed of the two following symbols :—

called "a dot and a dash," and thus, as some one briefly said in describing this simple system, "*that's the long and the short of it.*"

"Necessity," it has been often pronounced, "is the mother of invention," and accordingly the necessity, or rather the impossibility,* to use electricity for the transmission, by a single wire, of messages in any other way than by a short pulsation and a longer one, caused the invention by Professor Morse of an alphabet on the "dot and dash" system, which has become the basis of every description of flashing signals. Still, however, as the ordinary mode of designating an ignorant man is to say that "he doesn't know his A B C," it may be supposed that it would be difficult for him

* By complicated and delicate instruments, liable to error, fac-simile copies of drawings or writings can now be transmitted by telegraph.

to transact business of every description by the use simply of "a dot and a dash."

The following table of flashes, however (which without any signal-book or code may be used either for spelling a message or for transmitting by a single symbol an important word of command), like Columbus's egg, at a single glance, explains the mystery :—

NUMERALS.

ALPHABET.

1 *Understood.*	2 *Not understood.*	A 5	3 *Go on.*	4 *Wait.*
B 6	C 7	D 8	E 9	F 10
G 11	H 12	I 13	J 14	K 15
L 16	M 17	N 18	O 19	P 20
Q 21	R 22	S 23	T 24	U 25
V 26	W 27	X 28	Y 29	Z 30

Now as the pulsations, long and short, of the

electric finger were able to deliver messages by an alphabet somewhat similar to the above, it was evident to Major Bolton and his colleague, Captain Colomb, that by any description of visual signals, which could be made long and short, a message with equal facility might be transmitted.

The first media which in 1861 they suggested were—

1st. In daylight.—The use of the common flag or banderol, of which a short wave, forming about a quadrant, would represent "dot," and a long or semi-circular one "dash."

2nd. In darkness.—The flash of a lamp which on being shown for a long or shorter period would be equally efficient.

The successful results of these experiments, after two years' consideration, were acknowledged as follows :—

Extract of Letter from the WAR OFFICE, *30th March*, 1863.

"SIR,

"I am directed to inform you, that in consequence of the very favourable reports which have been received from Chatham, Aldershot, and Portsmouth, of the results of practical trials made at those stations successively with your Signals and general System of Telegraphy, the Secretary of State for War, with the concurrence of His Royal Highness the Field Marshal Commanding-in-Chief, has decided upon the adoption of your plans into Her Majesty's Services.

"In making this announcement, I am directed to convey to you Sir George Lewis's high sense of the valuable ser-

vices you have rendered in bringing your plans to their present state of perfection.

"I am, &c.,

(Signed) "EDWARD LUGARD.

"*Captain Bolton,*
12th Regiment, Chatham."

In the above letter was transmitted the following enclosure :—

Extract from Report of the Ordnance Select Committee on the subject of a Reward to Captain Bolton, 12th Regiment, for Invention on Military Telegraphy.

"Repeated attempts have been made since 1855 to utilise the electric, and the lime or oxyhydrogen light, for military purposes.

"Captain Bolton is the first who has succeeded in doing so, and this success has been mainly due to his practical knowledge of the requirements of the service, and the exercise of an uncommon judgment in the successive steps of his invention.

"In addition to thus perfecting an apparatus for night signalling, and reducing it to a cheap and portable form, Captain Bolton has thoroughly worked out the telegraphic system itself, and shown the facility with which intelligent soldiers can be trained as army signal-men, thus placing at the command of the military and naval service, for the first time, a resource of the utmost practical value."

After the lapse of sixteen months' "further consideration," the progress of the invention was made known to the public as follows :—

'*Times*,' *Saturday, August 20th*, 1864.

"The Lords of the Admiralty terminated their official visit of inspection for the present year at Portsmouth

yesterday. In the morning the Duke of Somerset, Vice-Admiral Sir Frederick Grey, Rear-Admiral the Hon. J. R. Drummond, with Mr. Romaine, C.B., and Captain R. Hall, private secretary to the Duke of Somerset, landed at the dockyard from the royal yacht 'Osborne,' and in the first instance proceeded on board the 'Pigmy,' paddle steam-tender, Master Commander Vine, lying alongside the south jetty of the yard, where they passed nearly an hour examining the signal apparatus fitted on board for carrying out the experimental signalling by day and by night, between positions in mid-Channel and Portsmouth Dockyard, under the direction of Captain Frank Bolton of the 12th Regiment, and Commander Colomb of Her Majesty's navy. Their Lordships expressed their gratification at the manner in which this effective system of joint naval and military telegraphy had been developed by the exertions of these two officers, and intimated that a committee would be at once formed by the Admiralty and the War Department to report upon the system with a view to its being at once incorporated as a part of the system of national defences."

Accordingly a committee was "formed," and the advantages of the flashing system having been endorsed by competent authorities, such as Rear-Admiral Sir Thomas Pasley, Bart., Commodore Wilmot, C.B., Captains Key, Jerningham, Hall, Risk, Pasley, Heath, Tremlet, and Aylen, it was "recommended to be adopted in Her Majesty's service."

The rate, however, of its advancement was so slow, that although an invention calculated to facilitate the movements of armies and of fleets essentially benefited regiments of cavalry and

infantry and the navy, rather than the movements of the corps of Engineers, upwards of a year elapsed before General Simmons, who had received a very favourable report of its practical utility from Lieutenant Sir Arthur Macworth, Bart., R.E., who in travelling in America during the war had noticed it in operation in General Grant's army, was by Her Majesty's Government authorised to draw up, with the assistance of Captains Bolton and Colomb (ordered to Chatham for the purpose) an improved code for communicating between Her Majesty's fleet and troops on shore, and also for general use in the army (as for some time had been previously practised by the Royal Engineer Train, at Aldershot).

A trifling instance of the practical value of this code I witnessed during my short visit at Chatham.

At a moment when the eyes of Lord Napier and others were fixed on a black bark, which, although lying placidly in St. Mary's Creek about three-quarters of a mile distant, was doomed to destruction, a barge was seen slowly bearing towards her.

By the mere long and short wavings of a flag by an Engineer officer standing close to General Simmons, the explosion was delayed until a few minutes afterwards, when on the talking flag saying "fire," up went, in mimic warfare, the black vessel with its cargo of dummy apparent human heads and limbs, which, revolving in dutiful obedience to the laws of gunpowder, in due time, according

to their respective gravities, fell in a series of splashes into the water.

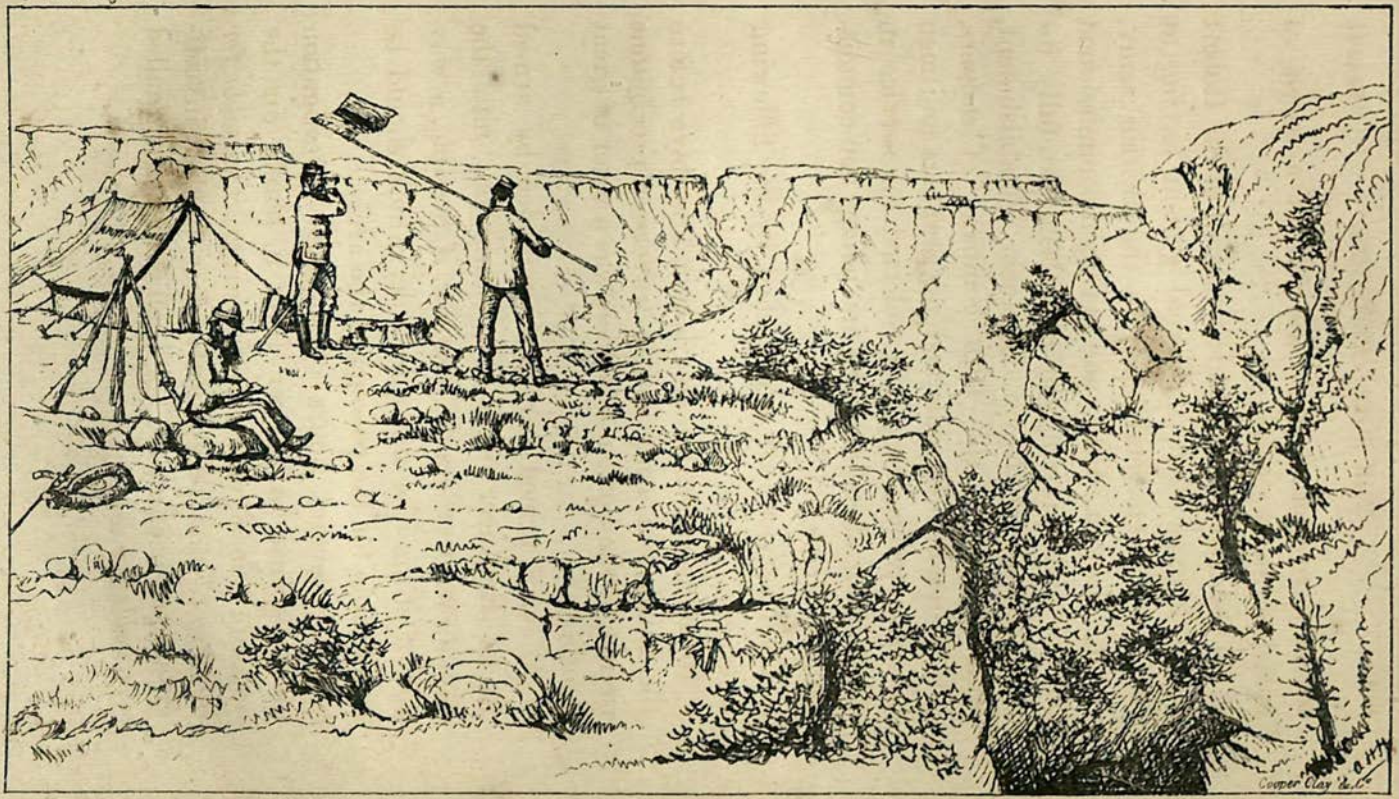
On the construction and formation of Sir Robert Napier's expedition, no signal system having at that time been established in the British army, Lieut. Morgan, R.E., and 11 non-commissioned officers and sappers who had been carefully instructed at the Royal Engineer Establishment, were posted to the 10th company of sappers, which in addition contained telegraphers and men of other trades, especially selected for service in Abyssinia. Total number, including non-commissioned officers, 83.

Their services are exemplified by the following facts:—

In the advance on Magdala, a few days before the attack, our army had to traverse a precipitous ravine, at the bottom of which was a river of great depth.

A small armed party, accompanied by armed Royal Engineer signallers, were sent into the ravine, with orders to discover, if possible, a way out of it on the opposite side, which should be practicable for the passage of the army.

After several hours of toilsome investigation and suspense, a sapper from a perch on the opposite side signalled to the army, "*passable for infantry;*" and very shortly, after further investigation had been made, his intelligent flag signalled "*passable for cavalry.*"



IN SIGHT OF MAGDALA. ONE SAPPER COMMUNICATING AND ONE RECORDING FLAG-SIGNALS.

London. John Murray. Albemarle Street.

Now if the exploring party had not been accompanied by the Royal Engineer signallers, the army, instead of at once proceeding, would have had to await the safe arrival of a messenger, who on attempting to return with his information might have been shot, and who, at any rate, would have had several hours' toil to scale the sides of the ravine to communicate his intelligence, thereby retarding it perhaps a day in its advance to Magdala.

The value of a day under such circumstances, when the army were on short provisions, would have been almost incalculable to any one except Sir Robert Napier.

The following samples of information transmitted by flag by sappers during the Abyssinian campaign, demonstrate the precise practical value of the system of flag-signalling.

1. From Captain Pottinger to 44th—

"What kind of encamping ground have you got, and how far off from the river?"

2. From officer commanding to Captain Pottinger—

"Encamping ground very good, strong positions, close to river."

3. From Captain Holland to Sir C. Staveley—

"3rd Dragoon Guards are to halt at Tacazze; 3rd Native Infantry at Scind. Order accordingly. Mules of the two regiments to be used for supplies."

4. From Sir Charles Staveley to Adjutant General—

"2000 lbs. flour, under Lieut. Sewell, reported close to camp."

5. From Major Baigree to Quartermaster-General—

"No report of any kind has been received from the rear."

6. From officer commanding to Quartermaster-General—

"Two natives just seized by picket. They report that Theodore has only 2000 men. Shall they be sent up? No guns in Fahla."

7. From Quartermaster-General to Major Chamberlain—

"Send the two prisoners up at once."

8. From Sir Charles Staveley to Quartermaster-General—

"Is the ration to be reduced all round, including those who do not eat meat?"

9. From Captain Pottinger to Major Murray, R.A.—

"Bring your battery up to Magdala. Better come on elephants. One hundred yards extremely steep."

10. From General Wilby to Quartermaster-General—

"Troops all safely withdrawn. Demolition of Magdala commenced."

During a series of experiments which I witnessed at Chatham, in which a sapper was made to communicate at a considerable distance, with another standing with the sky at his back, on the summit of the Spur Battery, I asked Major Bolton whether his system of signalling could be easily performed on horseback. At the word off he started, and, at what is termed a hunting gallop, I kept on his left side and saw him, by movements with his flag very closely resembling cuts 1 2 3 4 in sword exercise, communicate an order to the sapper on the distant battery, who in return signalled to him as we galloped along that it was understood.

With this fact before me I could not but reflect what a noble field was here offered to young

officers of the line, and most especially of cavalry, being good riders, and holding staff appointments.

Under the old plodding system of despatching aide-de-camps, and awaiting, what under the improved fire-arms of the present day may never happen, namely, their return, dashing cavalry officers, aide-de-camps and officers of the Quarter-master-General's department, when almost in the reach of the sabres of their pursuers, could on thoroughbred horses continue to signal to their army the strength and the masked movements and intended surprise of its enemy.

In like manner, on pickets being driven in and the enemy advancing, an officer, non-commissioned officer, or soldier could, as they fell back, convey to the main army most important intelligence.

In short, if the system were, by our infantry and especially by our cavalry, zealously and scientifically brought out, flags flashing by day and will-o'-the-wisp lights winking by night — here, there, and everywhere—would be able to transmit intelligence and orders of every description.

But although the system of visual signalling is, I believe, infinitely more important than I have been able to explain, a description of its details really breaks down altogether from its sheer simplicity.

Every soldier in every regiment can wave his hand, his cap, a green bough, or a flag, his shirt, or anybody else's shirt or apron, affixed to a walking

stick, forming the whole of the apparatus he requires. Again—in using what is majestically called the "collapsing drum," a simple barrel composed of crinoline sides, any man can pull the string which brings its wooden top and bottom together—another exemplification of the "dot" and the "dash."

The only atom of science in the whole system is to learn to read and use the electric or "dot and dash" alphabet, and established vocabulary of words or sentences to be communicated without being spelled. Such as, "Send artillery." "Send cavalry." "Send skirmishers." "Recall skirmishers." "Fire the mine," &c.

Now to learn to use this alphabet, all that a soldier or any one else has to do, is, either when sitting, standing, walking, or recumbent, to close the third, fourth, and fifth fingers of his right hand, leaving his forefinger and thumb to project.

Here at once he has before his eyes, or, if he prefers it, under his bed-clothes, the whole secret—"*thumb*" representing the dot, "*forefinger*" the dash.

With them he can learn his electric alphabet, and when he has learnt it he can by them communicate to his comrade-signaller just as effectually and, in his barrack-room, infinitely easier, than by waving a flag; and when one considers for how long a period our regiments of cavalry and infantry remained ignorant of this simple important element

in modern warfare, in which they are now at last "ordered" to be instructed, it is impossible to refrain from sorrowfully saying—

"Quantula sapientiâ regitur mundus!"

THE FIELD-SIGNAL STATION

consists of a small patrol tent, (capable of sheltering two trained signallers, with also, when necessary, four "look-out" men) of strong unbleached calico, in form resembling a common gipsy's blanket lair; its floor a waterproof covering of india-rubber on one side, camlet cloth on the other. With this tent is carried cooking apparatus and utensils for the signallers, also a complete set of tin-man's tools for repair, in the use of which they are instructed.

Moreover, an apparatus for signalling in darkness or daylight—the flashing field Chatham light for night, the flag by day, and the fog-horn for use during mists or in forests.

A supply of spirit and Chatham powder for the lamp in sufficient quantity for eight days' consumption can be carried in knapsacks specially arranged for the purpose, a larger supply being stored in the panniers.

A small portable "office" (it was barely big enough to admit into it my hat), is ingeniously supplied, to enable the signaller, who like the ostrich hides only his head, to prepare or write his

messages during the most inclement weather, and a small signal-lamp held close to it gives light at night, without being seen by the enemy.

Lastly, a box of stationery for the preparation of despatches.

The whole of the above, with cooking and other apparatus, are packed in two small panniers, waterproof inside, and with the tent constitute a load for one pack-animal.

The fog-horn, sixteen inches long, two inches at the bell, and weighing about six ounces, was, on trial, distinctly heard from the Spur Battery, Brompton, across the town of Chatham to the top of the Star-hill, Rochester, a distance of about one mile and a quarter, across a noisy town.

When the air has been in a state of rest it has been heard about three miles, and, strange to say, its sound sets all the donkeys in its vicinity braying.

THE CHATHAM LIGHT.

At 10 P.M., at which hour it happened to be unusually dark, I accompanied General Simmons to witness an exhibition of the "Chatham Light," as proposed by Major Bolton and Captain Colomb, proceeding from a lamp in shape and size resembling that of an ordinary carriage-lamp, containing within it a receptacle fitted with a mixture of

magnesium in powder and lychopodium (puff-ball), and a small spirit lamp.

By the action of a pair of bellows, this mixture disturbed and thrown up in three jets through the flame of the spirit-lamp, creates a bright flash, which the bellows making long or short, constitutes the flaming exemplification of what—including flag-waving and other manual signals — is now termed, generically, "*The flashing system.*"

A non-commissioned officer of Royal Engineers with a foraging cap on his head, and two honorary badges on his scarlet coat, after working his bellows, adjusting his lamp, and then gravely shutting its door, proceeded to deliver a signal, which had scarcely left him, when, to my astonishment, I saw, in the pitch darkness that prevailed, suddenly burst into existence a light (about the size of an ordinary saucer), such as, throughout this earth, nine hundred and ninety-nine out of every thousand pairs of human eyes have, it may confidently be said, never witnessed—and certainly mine belonged to the majority.

One could not say of it,

> "Twinkle twinkle little star,
> How I wonder what you are,"

for it was as superior in brightness to any ordinary planet as a tallow rushlight is to an ordinary jet of gas; and as it kept on conversing with the serjeant in the foraging cap by my side, its winks, long and short (their duration was about in the proportion

of three to one), gave to it a supernatural appearance.

According to my watch, the whole alphabet was communicated by this light in 29 seconds, say 60 per minute, or 12 words of 5 letters each.

From an ordinary policeman's hand-lamp (capable of being carried in the pocket at a gallop, to be lighted only when required), flashes long and short, by a hood worked by a little lever on the handle, can communicate signals for about three miles. Larger lamps, of the size of the tail red lights of a railway train, containing a bull's-eye and reflector, communicate farther—say six miles; and, when fitted up with regulators for concentrating upon lime through two angular jets, oxygen and hydrogen gases as invented by the late Lieutenant Thomas Drummond, R.E., and ingeniously adapted by Major Bolton, flashing signals by winks have been communicated between Dover and Calais.

CAPTAIN COLOMB'S NIGHT SIGNALS,

which, contained in an apparatus weighing about 80 lbs., can be communicated by electric light, lime-light, candles, or oil, are produced by a simple contrivance, which, by means of a lever, raises or depresses the shade of a large lamp suspended from the extremity of a sort of gibbet.

In the signal-box lives a small drum turned by a handle like a barrel-organ, which, by a clever

movement, undisturbed by the rolling or pitching of a ship, acts upon the shade.

In consequence of the power and success of this system, the Lords of the Admiralty, on the 27th October, 1863, ordered its adoption by "each ship of the channel squadron and by each line-of-battle ship and frigate on the Mediterranean station."

And accordingly, in the channel squadron at sea, nearly as many signals are now transmitted in darkness as in daylight, the value and importance of which, in time of peace as well as in war, it would be difficult to exaggerate.

By a joint order "issued under the authority of the Secretary of State for War, and the Lords Commissioners of the Admiralty, and with the concurrence of His Royal Highness the Field Marshal Commanding-in-chief," an army and navy code of signals, to enable communication to be made between Her Majesty's ships and troops acting on shore, now before me, has just been printed; but as it has been very properly desired that this "code" should not be copied, I refrain from making from it any extracts.

I hope, however, I may be permitted to point out the great advantages that would accrue if a system of signals were to be made general, for army, navy, coastguard, police, volunteer rifle-corps, in short, for all branches of the service, public and private, interested in maintaining order.

For instance, in the Fenian disturbances of last year, how great would have been the advantages of a coasting vessel or man-of-war running in within sight of any coastguard station, to communicate to, or receive from it intelligence—while the constabulary or police, by the same code and under the same system, were simultaneously communicating from station to station with the military and coastguard!

The experiments I witnessed of "Signalling by Light" ended at 11·30 P.M. At their conclusion, by its lamp, I counted as volunteer observers, sixteen young Engineer officers, one bugler who told me his age was fifteen, and one naval officer.

The extinguishing of the non-commissioned officer's lamp was to me a moment of interest, as it concluded my pilgrimage through the numerous halls of study of the Royal Engineer establishment at Chatham.

In taking leave of them, I shall refrain, as I hitherto have refrained, from expressing any opinion as to the zeal with which the several instructors and assistant-instructors perform their arduous duties.

1st. Because I feel it would ill become me to pass judgment on my superiors, and

2nd. Because I well know that they would infinitely prefer a bare recital of those duties to any incompetent observations that I could offer thereon.

As a gauge or measurement of those duties, I will, therefore, simply remind the reader that upon one instructor and his assistant devolve the subjects of Electricity, Submarine Mines, Chemistry, Telegraphy, Photography, Photolithography, and Signalling by Sight and by Sound.

THE LAST SIGNAL.

"Go, my boy, and if you fall, though distant, exposed, and unwept by those that love you, the most precious tears are those with which Heaven bedews the unburied head of a soldier."

The Vicar of Wakefield.

Among all the boundaries that delineate great empires, small nations, parishes, and estates, there exists no line of demarcation more clearly defined than that which separates the glorious duties of our cavalry and infantry regiments from the dangerous but less resplendent duties of the corps of Royal Engineers.

Upon the colours of the two former branches, or rather the laurel-branches of the British Army, are inscribed, and in the monthly 'Army List,' dated "WAR OFFICE," and published **By Authority**, are honourably recorded, as, for instance,

1ST ROYAL DRAGOONS.

The crest of England within the Garter.

An Eagle.

"Spectemur agendo."

"Peninsula."

"Waterloo,"

"Balaklava." "Sevastopol."

GRENADIER GUARDS.

A Grenado.

"Lincelles." "Corunna."

"Barrosa." "Peninsula."

"Waterloo." "Alma."

"Inkerman." "Sevastopol."

And, moreover, only a few days ago, in the 'Times' of the 2nd of November, all classes of people rejoiced to read that—

The Adjutant-General, Lord William Paulet, has announced in general orders that Her Majesty the Queen has been graciously pleased to sanction the following regiments bearing the word "*Abyssinia*" on their colours, in commemoration of their services during the Abyssinian Expedition of 1867-8:—The 3rd (Prince of Wales's) Dragoon Guards, 4th (King's Own Royal) Regiment of Infantry, 26th (Cameronian) Regiment of Infantry, 33rd (Duke of Wellington's) Regiment of Infantry, and the 45th (Nottinghamshire, Sherwood Foresters) Regiment of Infantry.

On account of the duties of the Royal Engineers and Royal Artillery being of a detached nature, and, moreover, being what is designated by the War Authorities *scientific*, no colours are allowed to be borne by them, and accordingly their services in Abyssinia, as well as in every other portion of the globe, have not been, and are not permitted in any way whatever, like those of the cavalry and the line, to be recorded.

Now whether it be loyal submission to this "regulation," or the natural result of education, which it has been truly said,

"Emollit mores, nec sinet esse feros,"

the fact or truth is, that not only has there never existed among the officers of Engineers what is called "*a Hero*," but such a character, if assumed, would instantly be frowned upon and extinguished.

No Engineer officer presumes to volunteer for dangerous work. When under fire from the enemy's batteries parallels are to be laid out, when saps are to be conducted, when shafts and galleries are to be sunk and driven, when mines against countermines are to be constructed, loaded, and fired, and lastly, when the assault of the fortress is ordered, for each and all of these duties some one or more Royal Engineer officers are "*told off*," exactly as, the day before, some one or more of them might have been "*told off*" to sit on a court-martial.

In short, as a naval captain takes a pilot on board not to fight his ship, but simply to steer her safely through hidden rocks into action, so does the Engineer officer clearly understand that his "*leading* the assault" merely means that he is to conduct the assailants to, and accompany them during, their perilous work, through certain intricacies with which he is, and they are not, professionally acquainted.

In performing this simple duty, if—like that overgallant officer who, after delivering to Lord Cardigan orders for the Balaklava charge, made the mistake (to himself a fatal one) of waving his sword over his head, as if to "lead the light cavalry" on—he were to presume to supersede the regimental officer in command, he would probably be put under arrest, and so justly would he offend the soldiers of the line that a rifle bullet through

his back might possibly what is called "put him in his proper place."

This line of demarcation between leading and fighting has been rather curiously exemplified by Captain Conolly, who, commencing his chapter headed, '1854: Siege of Sebastopol, 18th of October, 31st of December,' with the sensational words, "*A corporal guides the field officer to the* 21*-gun battery in open day,*" proceeds to state that after Colonel Hood, of the Grenadier Guards, the field officer of the trenches, was killed, Colonel Walker, of the Scots Fusilier Guards, selected Corporal Collins, R.E. "as a sure guide" to conduct his attacking party from the Engineers' park, by the sailors' camp, into the ravine, then along the Woronzoff road, to the foot of a watercourse leading to the hill on which was situated the 21-gun battery, "*where the Colonel* DISMISSED *the Corporal,* and dashed on alone into the work."

A clearer explanation of the military distinction between "*meum*" and "*tuum*" could scarcely be found.

To all general rules however there are occasional exceptions, such as occurred at the storming of Magdala, the arrangement of which, for the sake of the sequel, in the fewest possible words, I will endeavour to relate.

At about 9 A.M., on the morning of Monday, the 13th April, 1868, the 10th Company of Royal Engineers, one company of the Madras Sappers

and Miners, with two companies of the Bombay Sappers and Miners, forming altogether a body of 310 men, the whole under the command of Major Pritchard (the commander of the 10th Company) advanced up King Theodore's road, *in rear* of two companies of the 33rd Regiment, until they reached the saddle of land, joining Selassee and Fahla, where, after moving off a short distance to the left, they climbed the precipitous cliff, passed round to the left of the high hill of Selassee, and advanced on Magdala in skirmishing order. The two companies of the 33rd Regiment, continuing up the King's road, passed over the hill of Selassee, and then joined the Royal Engineers. After a little firing the force halted until about 4 o'clock, when the 10th Company of Royal Engineers, with a company of Madras Sappers and Miners, carrying ladders, entrenching tools, and two barrels of powder, fuze, &c., led by Major Pritchard, and followed by the 33rd Regiment, proceeded along a narrow path 3 feet broad, bounded by a precipice on the left, and a precipitous rock on the right, up to within 15 yards of the gate or porch (15 feet square) of Magdala.

On arriving at this point, the enemy, through loop-holes, suddenly opened a heavy fire, which wounded almost simultaneously Major Pritchard in the shoulder and arm, two non-commissioned officers and one sapper, Lieutenant Morgan being

also contused by a blow on the head and on the shoulder by stones.

One of the loop-holes giving much trouble, Major Pritchard ordered it to be covered by Sapper Chamberlain, who, placing his Sneider rifle into it, without removing it, kept up a brisk continuous fire, which loading at the breech enabled him to do.

In like manner Lieutenant Morgan, R.E., by the insertion of his revolver, silenced more than one of the loop-holes, until Lance Corporal McDonagh, climbing over the loop-holed wall to the right of the gate, was the first man that got in there, while Major Pritchard, by means of a ladder, almost simultaneously at another point, also got in with Sapper Bailey, who, when on the top of the wall, waved his army signal flag which, besides his rifle, it was his duty to carry.

While Theodore's generals and troops were thus driven from the loop-holes of their gateway, the 33rd Regiment seeing that in the narrow path leading to it there was no space whatever for them, most gallantly rushed forward to the right, where, by clambering over a dwarf wall, and over an almost precipitous rock, they forced their way into Magdala, and therein joining Major Pritchard's force, both together pursued the enemy through the second gateway (passing together Theodore's corpse), and then across the town, keeping up a heavy fire before which the enemy, they had

marched so many miles to meet, was seen flying in all directions.

Of this joint affair Lord Napier, in his despatch dated "Commander-in-Chief's Office, Head-quarters, Camp, May 12th," and published in the 'London Gazette' of the 13th June, 1868, stated—

"The Royal Engineers and Sappers and leading sections of the 33rd Regiment were long before they could force an entrance, and during that time nine officers and men of the Royal Engineers and Sappers received wounds or contusions."

Having narrated the foregoing anecdote—for as compared with the slaughter at the assaults of our gallant regiments in the Peninsula or Crimea * it is really little more—I will now abruptly submit to the reader the following extract from a letter published in the 'Times':—

DEATH OF LIEUTENANT MORGAN, R.E.

"It is with great regret we have to record the death of Lieutenant Jeffrey Llewellyn Morgan, of the Royal Engineers, in Abyssinia on the 26th of April. This young officer left Chatham with the 10th Company Royal Engineers, on the 4th of November last, in charge of a party of men of the A Troop, Royal Engineer Train, who had been specially instructed in the system of signalling which has since been approved for

* During the latter part of the Siege of Sebastopol the Russians lost 3000 men per day. Their total loss in the war was about 250,000, buried in about 300 graveyards.

On the 8th September, 1855, 40,000 men were prepared for the assault, the Russians on that day having 1100 guns ranged in position against the Allied Army. According to official returns, our losses in the Crimea during the eleven months of the siege were in killed, wounded, and invalided, 29,953.

the service. Having landed at Annesley Bay on the 12th of December, he took up the first detachment of British troops which reached Senafé (native Indian troops only having previously traversed the Koomaylee Pass), making the march with 16 men of the Royal Engineers and 36 mules. In this march, which was one of considerable hardship, the road not being then made, Lieutenant Morgan had to manage for himself without the assistance of muleteers, none of whom could be spared, and it is much to his credit and that of his men that he accomplished the distance in six days without the slightest casualty, considering that the British soldier is not accustomed to mountain passes or to the charge of mules. After Sir R. Napier joined the force in the highlands, Lieutenant Morgan accompanied the head-quarters of the army, and during the advance instructed parties of men of various regiments in the use of signals, so as to make the appliances, of which he was in charge, as useful as possible. He appears to have made himself always conspicuous not only by taking every opportunity of making his signalling apparatus useful, but also by using his best energies and those of his men in assisting to overcome the difficulties met by the force in its arduous and perilous advance. An officer writing of him says, that he had noticed how perseveringly he walked at the head of his men, and how kindly he always treated them; he was afraid he walked too much for his strength, though he had a horse to ride; and one of his last acts, before he was laid up, was to carry a heavy coat for a tired soldier during a long march. He had suffered from fever before the day on which Magdala was taken, but was better on that day, and said how glad he was that he had strength to accompany the men of his corps who led the storming party, in which service he received a slight wound. Sir R. Napier has marked his appreciation of this gallant young officer's character and services by a general order, with which we conclude this notice:—

"*Extract from General Orders by Lieut.-General Sir R. Napier, G.S.I., K.C.B., Commanding-in-Chief Abyssinian Expeditionary Force.—Camp at Takazze River, April* 27, 1868.

"The Commander-in-Chief has received with great regret the report of the death of Lieutenant Morgan, R.E.,

in charge of the signallers of the 10th Company, R.E. Sir Robert Napier had constant opportunities of observing the unflagging zeal and energy of this young officer, and the cheerful alacrity with which he embraced every opportunity to render his special work useful to the force. Lieutenant Morgan set a bright example to those under his command, and by his premature loss—owing to prolonged exposure and fatigue—Her Majesty's Service and the Corps of Royal Engineers are deprived of a most promising officer.

(True extract.) "W. E. MACLEOD,

"Lieutenant Colonel, Assistant-Adjutant-General.

"HEAD-QUARTERS, ABYSSINIAN EXPEDITIONARY FORCE."

To the above graphic account of the death of Lieutenant Morgan, one of the ablest of the "Special Correspondents" added,

"*He was one of a thousand,*"

and his extraordinary attachment to the men of his company, and *vice versâ*, certainly authorised the assertion.

Without interfering with his duties, which, including the command of the Signalling Department, were multifarious, he was regarded by his men as father, mother, brother, and sister. They confided to him not only their domestic histories but the inmost secrets and affections of their hearts.

On quitting Zoulla, although he was weak in constitution, and although day by day diarrhœa made him weaker, still, declining to go on the sick

list, he persisted in proceeding on foot from Senafé to Magdala, more than 300 miles, with his men.

"On one occasion, Lord Napier in passing, seeing how ill he looked, ordered him to mount his horse. This he did for a short time, but soon was marching again with his men."

On the morning of the assault on Magdala he was so feeble, so ill, and overdone by fever, that he told his sapper servant that "*he felt all was over with him.*" Still he persevered in signalling between the advancing column and the reserve, until, with his revolver in his hand (as described), onward he led his men to silence the loop-holes of the gate of Magdala.

But the excitement of the attack, and the blow by a stone on his head were more than that shattered citadel could bear. The next morning, from brain fever, he was found perfectly unconscious, and in that state, with two sappers told off to nurse him, tenderly nourished almost every five minutes with a spoonful of cooling mixture, he was carried by native dooley bearers in a palanquin for a fortnight, during which time, slightly recovering once for a few minutes, after expressing "a wish that he might have seen his family again," he added, that he was perfectly resigned to his fate. Shortly afterwards, one of the sappers, returning to him, found him, at 2 P.M. on Sunday the 26th April, lying *dead.*

The next day, followed by a procession on foot,

composed of Sir Robert Napier, his secretary, his aide-de-camp, and about fifty or sixty others, his corpse, lying in a dooley suspended from two poles, which enabled the men of his company, as they carried them on their shoulders, to look down upon it, were conveyed along the valley of the Takassee to the precincts of one of the oldest churches in Abyssinia, where, after the funeral service had been read by the Chaplain of the Forces, the Rev. E. S. Goodhart, the body was lowered into its grave.

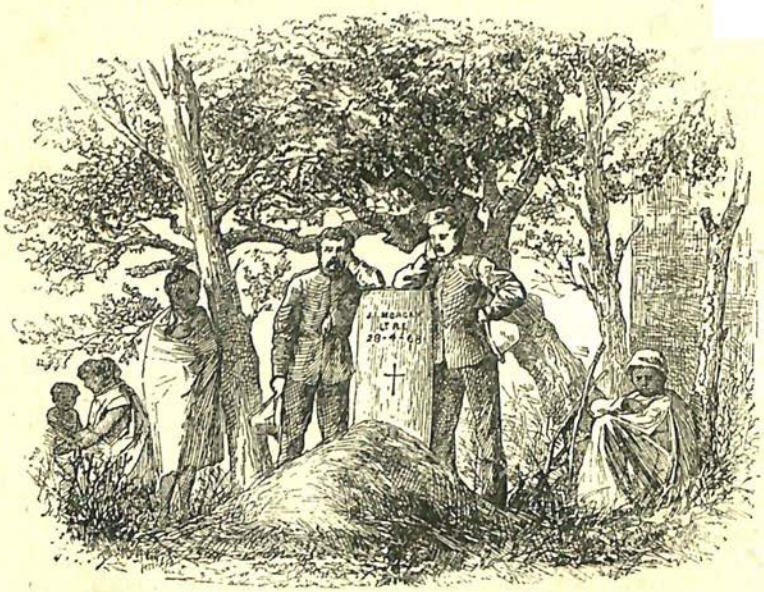
During the procession, and especially at that moment, the men of the 10th Company, it need hardly be said, were overwhelmed with grief, but when in the performance of their last duty to their departed officer, they shovelled down earth upon the great coat in which, as a soldier's shroud, he lay pale and emaciated beneath them, the scene, as it was described to me by one who witnessed it, I feel ought never to be divulged.

As soon as the band and firing party of the 4th Regiment had retired, the sappers set to work, and in a very few hours constructed and erected a gravestone. Before, however, they could be made to leave it, Serjeant Harrold, R.E. took for them a photograph of it, the grave, and a group of mourners, a part of which is engraved in the fragment on next page.

Resting on one side of the stone, is Serjeant Deans, R.E.

On the other side, Sapper Lucas.

(Serjeant Rogers and Private Wilson of the 33rd Regiment—both of whom had been taught signalling by the deceased—Major Pritchard, Lieutenant Le Mesurier, R.E., other officers, soldiers, and lastly several Abyssinian priests standing bare-headed, are included in the perfect photograph before me).



THE ROYAL ENGINEER.

THE 10TH COMPANY.

During my short journey through the Halls of Study in Brompton Barracks, I was much pleased by what people who do not understand and appreciate high-minded sentiments might have considered as the neglect with which I was treated.

If I had visited the Royal Engineer Establishment from private curiosity, I believe my reception would have been of an opposite character; but, as its object was well known, and clearly enough made known by myself, the line apparently taken by the instructors (all excepting one, lieutenant-colonels) was, not to speak till they were spoken to; and accordingly, I believe in almost every instance, I obtained whatever information I desired from the lieutenants acting as their assistants.

In no case did any one of them give me an ounce more information than I had asked for, nor during my whole visit did I receive from any individual a word of voluntary complaint.

In short, occupied in the performance of their own arduous duties, all appeared to take no heed in the performance or non-performance of the duties of others. Still, however, I could not but perceive from facts, documents, and data lying before me, and from observations which have been made to me by officers of artillery * of high standing

* The names of Colby, Howard Douglas, Martin Leake, Sabine, and Lefroy, sufficiently testify the scientific character of the officers of

that both services are greatly impeded in their career by what they term "the utter want of any recognition of Science by the War Authorities."

I shall venture before concluding this volume, to submit, in exculpation of the *present* "authorities," a few facts bearing on this important subject; however, I will not delay in the meanwhile to narrate the following story, which I believe but too clearly speaks for itself.

With the single exception of the field-officer, Major Pritchard, R.E., commanding the 10th Company, Royal Engineers, and the Bombay Engineers, all officers commanding regiments who joined in the assault of Magdala, and who *followed* Major Pritchard towards its gateway, have been selected for and rewarded by that highly coveted military distinction, "*the C.B.*"

Now, if it be true that in the British service alone an unfavourable distinction is to be drawn between its scientific and unscientific branches, it may as truly be stated that Major Pritchard's claims are comprehended within both categories, for—

1st. The Sappers he commanded, sent out to Abyssinia from the Royal Engineer Establishment for the express purpose of telegraphy, photography, American pump-sinking, and army signalling, as men of *science*, rendered, nourished, conducted, and

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the Royal Artillery, of whom six or eight are Fellows of the Royal Society.

by the waving of flags communicated intelligence and orders to the army from Zoulla to Magdala.

2nd. As *unscientific*, or, as the favoured class are termed, "fighting men," Major Pritchard, as described, not only led the Engineers to the assault on the gate of Magdala, but in doing so he and Lieutenant Morgan, R.E., were, of all the gallant assailants, the only officers that were wounded.

Moreover, Major Pritchard is, I believe, the only regimental officer with the Abyssinian army who was present in the two combats; namely, the battle of Arogee on Good Friday, and the *feu-de-joie* or storming on the following Monday of Magdala, for which double service although he, as the representative of "*the scientific*," has been excluded, five of his non-commissioned officers and men have received distinguished-conduct medals, which actually at this moment hang on their breasts, while that of their leader and commanding officer, Lieutenant-Colonel Pritchard (for he has lately been included in the brevet promotion), remains undecorated!

Lieutenant-Colonel Pritchard certainly did not, as poetically imagined by a Prime Minister, "Plant the standard of St. George on the mountains of Rasselas;" but as the colours of every regiment present in the two combats, by royal command, now proudly bear the word "*Abyssinia*," surely the initial of that word, that is the letter A, might be ordered to be inscribed on the Royal Engineer

signal-flag, which Sapper Bailey, by the side of his wounded commanding officer, waved in triumph on the captured citadel of Magdala. And if "the rule of the service" should declare this act of apparent justice to be impossible, would it not, I humbly submit, be a graceful opportunity for alleviating that other "rule" which is excluding the commanding officer of the 10th Company Royal Engineers (see his former services, Appendix C., No. 2), from receiving and wearing the "C.B." a distinction so honourably won and now worn by all regimental commanding officers engaged, either in the battle of Arogee, or in the storming of Magdala?

THE PUZZLE.

"There are some things that *no* fellow can understand!"
Lord Dundreary.

Shortly before I left Brompton Barracks, I heard from various quarters that General Simmons, by an order from the War Authorities was to be immediately superseded, not for any reason, but simply in obedience to a "*rule*" which decreed him unfit any longer to direct the Royal Engineer Establishment at Chatham in consequence of his having attained the rank and experience of Major-General in the army.

In the line, an officer, whatever may have been his services in the field, is considered to be *too*

young to command an army, or a division of one, until he has reached the rank of Major-General; and accordingly, when he does attain that position, he is very properly removed from commanding a regiment, for the obvious reason that if he remained in it, his commission growing older and older every day would authorise him to overrule any junior Major-General of high talent selected to command the division or brigade comprehending his regiment.

Now, as on the bed of Procrustes, people of all statures were by "rule," rather than by reason, promptly reduced to exactly the same length, so has a "rule" very reasonable, as regards the line, been, I submit, unscientifically applied to Major-Generals of the Corps of Royal Engineers, by reducing them to exactly the same position as if they belonged to the line.

And to this rule there has been linked a conflicting one, which although I feel it is utterly impossible to do so, I will endeavour to explain.

The conflicting "rule" to which I refer is, that the "Lieutenant-Governor Commandant" of the Royal Military Academy at Woolwich *must* be a Major-General.

Now, while I was at Brompton Barracks I happened to meet there three of the four undernamed officers:—

	Date of Commission.
Major-General Freeman Murray, Commanding Chatham Garrison	7 July, 1862.

	Dates of Commission.
Major-General Frome, Commanding the Corps of Royal Engineers	5 Jan., 1864.
Major-General Ormsby, Royal Artillery, Lieutenant-*Governor* Commandant of the Royal Military Academy, Woolwich	6 April, 1866.
Major-General Simmons, R.E., *Director* of the Royal Engineer Establishment	17 Mar., 1868.

The tangled skein, which I am incompetent to unravel, is that while by "rule" No. 1, Major-General F. Murray, is deemed not too old to command Chatham Garrison, including in it Major-General Simmons, R.E.—and while Major-General Frome is deemed not too old to command the whole Corps of Royal Engineers—Major-General Simmons is declared to have become too old to continue to be "Director" of the Royal Engineer Establishment; and yet by rule No. 2 to have become exactly old enough to be "Lieutenant-Governor Commandant" of the Royal Military Academy for the direction of which a Colonel of Engineers or of Artillery is declared to be "*too young!!*"

And accordingly, under these two conflicting "rules," only a few years ago the late respected and beloved General Henry Sandham, R.E., on attaining the rank of Major-General, was actually removed as *too old* from the Directorship of the Royal Engineer Establishment at Chatham to be Commandant of the Royal Military Academy at Woolwich, for which, all the time he commanded the former, he would have been considered by the War Authorities as "*too young.*"

As regards Science. These two inexplicable conflicting "rules" have just removed from Chatham a young experienced officer (it appears from Hart's 'Army List,' (see Appendix C), that he has received the Crimean medal and clasp, the Turkish gold medal for the Danubian campaign, the order of Medjidie third class, and a sword of honour from the Turkish Government), at the critical moment when he was engaged in important military experiments, submarine and others such as I have described, founded on data, many of which have been imagined and collected by himself.

Until the value of these experiments had been tested, it was due to SCIENCE, and it would, I humbly consider, have been advantageous to the British Service, had Major-General Simmons's removal, if deemed necessary, for a short period been delayed.

However, in his present retirement he has reason most gratefully to reflect, that between the fate of "the Clerk" and the Royal Engineer "Director of Chatham" there will for ever exist in history this important difference, that while the former, for certain clearly expressed reasons (see Title-page), was *hung*, the latter, for precisely similar reasons, was merely "*suspended*," a sentence neatly abbreviated by all eminent Judges by the Latin syllable,

"Sus."

DINNER.

As soon as a bugler, in obedience to the order of his commanding officer, the round-faced barrack clock, had played his ordinary seven o'clock tune, ending with the words "Roast Beef of Old England," a large group of officers who, like bees at the entrance-hole of their hive, had congregated in front of a door, entered their mess-room in which, in a very few minutes, I found myself seated at about the centre of a very long table. Before me were a line of about forty young figures and young faces which, during dinner, I repeatedly gazed at with indescribable pleasure.

All young people are good looking, youth itself is handsome. Those before me were not only both, but, in other respects, they appeared to me generically to resemble each other as closely as a row of early green peas in a pod. All looked happy, and although in their countenance, intellect and intelligence were occasionally seen to shine out brightly, yet nowhere could I detect a dull face trying to look sensible, or one guilty of any other description of guile.

We had all been working throughout the day hardly, all our heads (at all events mine) had ached, and now all had met to put their sculls to-rights to the old-fashioned tune of "Begone dull care, I prithee begone from me."

The dinner was plain, abundant, and excellent. Where I happened to sit, I found that between Scylla and Charybdis, steer which way I would, I fell foul of a glass of light champagne. On the whole, however, very little wine was drunk—one or two before me, possibly as a compliment to the inventor of the American tube well, imbibed water. However, ere long, some forty or fifty young officers simultaneously rose and departed, followed very shortly afterwards by the remainder of the party, all of whom reassembled in the withdrawing room, where, in various groups, standing, sitting, and reclining, some merrily talked, some sedately smoked, while some, taking up books or newspapers, read.

All of a sudden Major-General Freeman Murray, the respected Commandant of Chatham Garrison, said something to some one, on which a whole group of young officers, congregating round a handsome rosewood pianoforte, and then opening their young mouths, burst out, as if by word of command, into a joyous and melodious chorus.

Since I last dined at a Royal Engineers' mess, rather more than half a century had expired, and although "*de mortuis nil nisi bonum*," I could not help rejoicing at the intellectual progress that had been made between the life I had, as a subaltern, to endure, and that which the young Engineer officers of the present day of their own accord now enjoy.

In the picture before me appeared, for a short time, Lieutenant H.R.H. Prince Arthur.

When I first heard of his having been appointed junior officer of the corps of Royal Engineers, I own I was totally unable to conceive how, what may comparatively be termed his gigantic national rank and his lilliputian regimental rank could possibly be made to work together. All I will allow myself to say on that delicate subject is, that if all the diplomatists in the world had assembled to frame a code to regulate the bearing which it would be advisable that he and his associates should respectively assume towards each other, it would, I believe, have been as miserable a failure, as if it had been decreed by an Act of Parliament.

Whereas nothing could be more perfect and more beautiful than the manner in which these well-educated well-disposed young people settled the affair between themselves. By unassuming manners, zeal in his duties, and benevolence of disposition, the whole governed by unusual good sense, the Prince with native born dignity maintained a position which all who conversed with him with equal care combined to support. Never, in the course of my life, have I seen a so-called complicated difficulty so easily disposed of.

A SOLDIER'S KNAPSACK.

During my short day at Brompton I not only had opportunities of seeing almost all the sappers quartered there, but I was permitted to inspect a small party of them in full uniform.

The extra height at which they are enlisted, the constant outdoor work they have to perform, the improved food which the working pay they earn provides, and the unremitting discipline which, as it is termed, "sets them up," physically constitute a fine body of soldiers.

I was particularly anxious, however, to be enabled to observe, not so much their stature as how they were equipped, and, on doing so, was pleased to find that the attention of the authorities has been directed to diminish the weight of the soldier's knapsack, and to render it on the march as little painful to him as possible. Nevertheless, it appeared to me that although the new knapsack proposed by the Committee of officers of which Lieutenant-General Eyre is President, may be an improvement on the old one, the action of the soldier is still greatly embarrassed by leather belts altogether broader than is necessary for the weight they support, by little straps of which at least two might be dispensed with, and from the want of a quarter of an inch of air-space between the burden and the back, at present heated by the pack.

However, generally speaking, I must say I have long been of opinion that

1st. Inasmuch as a trained soldier, by the time he is really brought into action, has been and is to his country a very costly animal—while on the other hand, a waggon-horse, a cart-horse, or a pack-mule, is, comparatively speaking, a very cheap animal—it is false economy to impose upon the dearer creature what, especially on wheels, could be much easier carried by the cheaper ones.

A lame hunter is, practically speaking, no hunter at all, and, in like manner, a footsore soldier, however experienced he may be, is no soldier at all—indeed his value is considerably worse than nothing; because while a lame hunter may be left in his box, it requires a box or carriage to carry the lame useless soldier.

2nd. That not only is weight very often unnecessarily imposed upon the infantry soldier, but that when imposed, it has been always unscientifically inflicted.

A man, like a windmill, is composed of revolving arms supported by a certain sub-structure, which, in the common windmill, consists of a solid building, one story high, having above it another slighter wooden story to support and enable the arms or sails to work.

Now supposing that instead of this upper slighter wooden story the mill builder was to substitute not one long strong solid iron support, but a close-

jointed chain, maintained and supported by a series of stout elastic india-rubber bandages, the working of his mill would be impracticable.

And yet such is the construction of man, whose skeleton at a single glance demonstrates that whatever weight he is required to carry, should be imposed not on the summit of his vertebræ, but on that solid lower fabric composed of the stout strong combined bones of his hips and legs constituting together a narrow table, which, however heavily it be laden, leaves the beautiful mechanism of the vertebræ perfectly free.

If the above theory should appear to be clear and simple, I venture to submit that its practical value might easily be tested by attaching the weight of an old-fashioned heavy knapsack to two detachments of soldiers of the same regiment, on a trial march of say twenty-five miles a day for a week, one half of them with the weight, as cleverly as our military authorities can devise, attached to the summit of the men's vertebræ, and the other half with the same weight, as cleverly as *they* can devise, attached, or rather reposing, on that portion of their body, elegantly defined by a French writer, as commencing "*where the back ends.*"

In the latter position the old soldier, during occasional halts on a march, or while on parade awaiting the arrival of an inspecting general officer, could (if he were permitted to commit the sin), either by means of a hazel stick or by a loop

or little hook affixed for the purpose to his rifle, transfer the whole weight of his knapsack to either: just as an Italian organ grinder, all the time he is serenading Philosopher Babbage, exemplifies to all by-standers the truth of the old proverb,

"Leve fit, quod bene ferter onus."

BARRACKS.

As throughout my life I have considered a dead, flat, gritty Parade to be a dry subject, and the interior of a barrack a very dull one, merely peeping into the rooms of the sappers, which of course were almost photographs of those of regiments of the line, I proceeded to

The Non-commissioned Officers' Library,

(supported by a voluntary subscription of one shilling a month, and managed by a committee of non-commissioned officers), a large, airy, carpeted room, furnished with mahogany black hair-cloth bottomed chairs, reclining settees, a long table covered with red cloth, upon which lay, in easy disorder, a stratum of books, newspapers, and reviews.

Around about three-parts of the walls were book-cases filled with well-bound volumes. On the remaining portion hung pictures, some in oil, others photographs of distinguished officers in the

corps. Among them I observed one described by his own autograph as follows :—

Arthur,
Lieutenant Royal Engineers,
August 9, 1868.

Many of the books and pictures were, I was told, donations of officers.

In this reading-room, in intellectual enjoyment after hard intellectual work, reclined, neatly dressed, three young non-commissioned officers of very favourable appearance.

The Non-commissioned Officers' Mess-room

is an airy room of insufficient dimensions, containing two long tables for one special purpose, and a bagatelle-board for another.

On the walls, as the audience or spectators of both amusements, were arranged several portraits.

About twenty or thirty non-commissioned officers dine here per day, in two lots—the first, say the most hungry, at noon, the second at one o'clock.

Breakfast commences at 6·25 and continues till 8. The meal called "tea" from 4·30 to 5·30.

After it, or rather to float on the top of it, "refreshment" is administered, to any who require it, until 10·25 in winter and 11·25 in summer, when the apartment, by order, is closed.

As a mess-room bears precisely the same relationship to a kitchen as an egg does to the hen that

laid it, or as all effects bear to the causes that created them, I ought, logically speaking, to have been conducted to the boiler and oven before going to the eating tables supplied by them.

However, into the kitchen I illogically walked, and therein found one male cook and two ditto sappers, who (when their services are not required), act as "waiters" to the non-commissioned officers, whose subscription to the mess, for cloths, washing, &c., is sixpence per month.

The Sappers' Recreation and Reading-room for all Ranks

is an airy room thirty feet long with three windows on each side. The walls opposite containing plain shelves, covered with glass, full of well-thumbed books plainly bound, like those of an ordinary circulating library.

The table was covered with chocolate-coloured cloth.

Adjoining I found, in two similar sized "recreation rooms," a quantity of small square deal tables, painted like oak, in size resembling those in London clubs, two bagatelle-tables, wooden sofas with wooden backs (similar to those to be seen occasionally in old-fashioned chimney corners), hard wooden-bottomed chairs, floor neatly carpeted with white sawdust, speckled with black iron spitting-boxes.

In the corner of one of these rooms I discovered,

with great pleasure, a rosewood pianoforte, much used by the men to accompany their songs.

The Coffee and Refreshment-room

contains, of course, a "bar," with, behind it, a sort of maid, or rather woman, whose husband, the non-commissioned officer in charge, is allowed to sell—on account of the recreation fund from which the provisions are supplied and which receives the profit—tea, coffee, lemonade, soda water, big German sausages, jam, pickles, pastry, meat pies, and other delicacies of the season.

While, as a privileged visitor, I was standing within the bar, a fine rosy cheeked, intelligent, eager-looking little bugler, of about thirteen years of age, came up to it and, with forage-cap cocked jauntily on one side of his head, for several minutes there he stood, with a half-pint white gallipot in his hand, unobserved by the woman, or as they say in the House of Commons, unable "to catch the Speaker's eye."

"*What does that young bugler want?*" I whispered rather confidentially to the stout lady in waiting.

Answer. "JAM."

The Canteen

has been established and maintained and, in accordance with War Office regulations, is managed by a committee of officers, who have, as a staff to serve in it—

1 canteen serjeant,

1 serjeant as clerk and accountant,

4 women—2 in the bar, 2 in the grocery department—(all either wives or widows of soldiers),

1 char-woman to "clean up,"

1 sapper store man,

1 lad that runs errands and "weighs up the tobacco" ("*and that's all HE does,*" concluded the canteen serjeant in giving me an account of him).

As this canteen is exclusively for the use of the Royal Engineers and their families, and (by permission) for that of any other corps quartered in Brompton Barracks, no civilian or member of any other regiment is allowed to make purchases therein.

Serjeants and first corporals are not permitted to go to it for the purpose of drinking, even with other non-commissioned officers. They have their own mess-room, to which, "for the maintenance of their position and character," they are, by General Simmons's printed "*standing orders*," recommended and required to confine themselves.

No beer or liquor is allowed to be taken into the reading or recreation rooms.

The Bar,

in one room, provides ale, stout, porter, lemonade, gingerbeer, soda water, cigars from one penny to twopence each.

The Grocery Department,

in another room, provides tea, sugar, white, yellow, and brown

"Coffee and spice, and all that's nice."

vinegar, starch, eggs (unwarranted), cheese, butter, thread, lucifer matches, postage-stamps, writing-paper, biscuits, bread, starch, and those other items which altogether constitute the "sweet home" of the soldier and his family.

On leaving this department there passed us a young person, fresh, good-looking, and what is infinitely better, "looking *good*."

"*What girl's that?*" said the general officer I was following, very gravely; and, exactly as gravely, the serjeant replied, "*She belongs, sir, to the refreshment-room,*" from which she had been despatched by her father with a message.

Large Subterranean Store-room.

A locomotive engine on one of our great railway lines, after it has been duly heated at the coke furnace, on being conducted by a set of rails to the water-crane, at one draught, for his breakfast, imbibes about a thousand gallons of cold water, sufficient to enable him to travel about forty miles. He then proceeds to the coke shed for his meal of coke, about one ton, a goods engine usually devouring about two and a half tons.

Now the appetite of a working sapper, although

altogether inferior to that of his brother locomotive, may be not very inaccurately gauged by the following data.

In the subterranean store-rooms I found the walls garnished with large fat hams, more hams and sides of bacon hanging from the roof, boxes of eggs, piles of jam, marmalade, jellies, cones of white sugar, a stock of stationery, and, stalking majestically amidst all, a black cat with four white feet.

The average consumption of malt liquor per month amounts to

160 barrels of porter,
23 „ of ale,
6 „ of stout.

The receipts of the canteen amount to (what on the continent of Europe would be considered a princely fortune), 14,000*l.* a year. Adjoining to it I found a healthy *skittle-alley*, thirty-nine feet long, divided for double sets, and

On the ground floor, the large *tap-room* (lighted by gas), thirty-two feet long by forty-two feet broad, containing forty small square tables, each broad enough to hold a pewter pot, with two opposite little benches to enable a couple of thirsty comrades to empty it.

In passing through this room, which was densely crowded, I had to thread my way through a fine athletic lot of men who, without stocks and with their fatigue jackets unbuttoned, seemed to be

thoroughly enjoying recreation and moderate refreshment after their hard healthy day's work.

All were in high good humour, but what appeared principally to create, or rather excite it, was the corps' Abyssinian monkey, a large, long-haired animal, whose careworn, frowning eyebrows, and grave, round mouth, suddenly changed —especially when he saw a merry little bugler approaching the tip of his tail—into a longitudinal array of two rows of grinning, chattering, ivory teeth. As he passed through the crowd on the shoulders of a tall, good-humoured, fine-looking sapper, holding tightly on by the hair of his head, the colour of which, as well as of his ruddy complexion, reminded me of *Rob Roy*, Theodore was in an extraordinary state of excitement. Several times I fancied he was going to bite the ear or face of his patron, who, however, with amusing nonchalance, strolled about with him.

On the return of the 10th Company to Brompton Barracks from Abyssinia, it was welcomed by a splendid banquet, for which the subscriptions were: officers, £26 17*s.* 6*d.*; non-commissioned officers and rank and file, £53 10*s.*; total, £80 7*s.* 6*d.* Serjeant-Instructor Kennedy composed for the occasion an address, of which a printed copy was presented to me, commencing,

"Hail to our Comrades of the Corps of Royal Engineers!
Hail to the brave! why should not we receive them with three cheers?"

Having now concluded my inspection of the Royal Menagerie which I had undertaken to visit, from its noblest inhabitants down to its Abyssinian monkey, I shut up my note-book, packed up my portmanteau, and bidding adieu to Brompton Barracks, joyfully sentenced myself to "return to the place from whence I came"—my own home.

THE PRACTICAL TEST.

IF the reader should feel only half as thankful as I do for having survived the wearisome journey along the highways and by-ways of the educations I have had to describe, he will, at all events he is entitled to, shudder when I unkindly inform him, that on leaving the Royal Engineer Establishment at Chatham, the education of the young engineer officer may be said, not to end, but *to begin*,—that is to say, he has by study, application, zeal, energy, and above all by humility, to make himself competent to execute, off-hand, the various and variegated duties, civil as well as military, in time of peace, as well as under fire, which at any moment he has now become liable to be called upon to perform.

However, before entering upon that undiscovered country, the future, I believe that the reader would prefer to ruminate for a few moments on the past tense, which evidently involves this most important question.

The education of "the Royal Engineer" at the Military Academy at Woolwich, and the subsequent instruction bestowed upon him, and upon "the Sapper" at Chatham, have cost and are costing the country annually a large sum of money which the British tax-payer is required to defray.

Now, does the country, or does it not, get money's worth for this large expenditure?

Everybody knows that between a philosopher and a fool there is a difference; but as regards the *distance* which separates them, there exist, although in very unequal proportions, conflicting opinions.

In like manner, it is undeniable that by dint of a triple education "the Royal Engineer" has on many points become what is commonly called "learned;" but the questions to be answered are: What is the precise value of his head-full of learning? Is it worth its weight in gold, silver, copper, lead, iron, or wood? And if wood, of what description of wood? each of which, from teak and oak down to elder and cork, has a different specific gravity.

Again, what is the intrinsic value, not to the soldier, but to the British taxpayer, of the "learning" that has been stuffed into the educated "Sapper's" head?

Now, Captain Conolly, whose valuable 'History,' in two volumes, has repeatedly been quoted, to the laconic question I wrote to him, "*What is a Sapper?*" replied, as I expected, by drawing up for me an able summary (see Appendix D), ending by the following quaint and clever exclamation:—

"Well may it be asked, 'What is a Sapper?' His versatile genius is, as Shakspere has already answered,—

'Not one, but all mankind's epitome!'

condensing the whole system of military engineering,

and all that is useful and practical under one red jacket. He is the man of all work, of the army and the public,—astronomer, geologist, surveyor, draftsman, artist, architect, traveller, explorer, antiquary, mechanic, diver, soldier, or sailor, ready to do anything, or go anywhere—in short, he is A SAPPER!"

Oh, yes! but I repeat, what is his intrinsic value?

Now, to be enabled practically to assay this, I wrote to Colonel Sir Henry James, R.E., with whom I was previously totally unacquainted, asking him to permit me to see the sapper at work in the great establishment (the Ordnance Survey) under his command, the head-quarters of which are at present comprehended in a series of buildings constructed, and formerly for a considerable time used, as Cavalry barracks, stables, &c.

With Sir Henry James's cordial permission, accompanied by Serjeant-Major Spencer, I spent half a day in observing what was before my eyes, and in listening to the instruction which from my mentor and from several of the working non-commissioned officers and sappers I received. The following, with a very few additions, I copy verbatim from my note-book in the irregular order in which I wrote them under the circumstances of my visit, which I beg leave to repeat was not to ascertain the duties of the nineteen engineer officers who are working under Sir Henry James's direction, and whose names I purposely omit, but merely what portion of that work non-commissioned offi-

cers and sappers—all of whom came to him from the Royal Engineer Establishment at Chatham—have performed and are performing.

1st. For Her Majesty's service.

2nd. For individuals and scientific bodies.

NOTES (*as they were written*).

In one fire-proof store, arranged so that any one of them can be taken out for use, 180,000*l.* worth of copper engraved plates, of which the metal alone is worth 18,000*l.* In another store, 730,000 new printed maps, copies of 'Doomsday Book,' Parish maps, of which are published about 80,000 acres per month, on a scale of about one square inch to an acre, 960 acres being supplied to the public for 2*s.* 6*d.* These maps, after being examined and zincographed, are reduced by photography to the six-inch scale, and engraved in copper forming county maps.

In a cellar, with double walls to obtain a mean temperature, Captain * * *, R.E., a mathematician of European celebrity, assisted by Quartermaster Steel and Serjeant Compton, R.E., receive the standards of different nations brought to be compared by micrometer microscopes (capable of measuring the fifty-thousandth part of an inch), and by a solid but most ingenious construction, with the English standard yard.

Ten zinc presses, eight worked by sappers.

Corporal Palmer (in uniform), aged 29, joined as a bugler, composing and executing most beautifully a title-page for MSS. book of the 'Tower of London.'

2*nd Corporal Goodwin's* Model of Jerusalem and its environs, executed in a composition made by himself, exhibiting all the streets, the city wall, the mosques of Omar and El Akhsa; the Church of the Holy Sepulchre; the Pools of Hezekiah and Bethesda; Zion, with the Protestant Church on the north, and the Mount of Olives, Valley of Kedron, Valley of Hinnom, the Protestant school, and English burying-ground on the south; the whole constructed by Goodwin, aged 33, from contoured maps made under the command of his Captain by Colour-Serjeant McDonald, and a party of sappers sent out to Jerusalem for the purpose, the expense paid chiefly by Miss Burdett Coutts.

A model section also made by Corporal Goodwin of passages and chambers in the Great Pyramid of Egypt, with models of the kings' and queens' chambers therein.

Arranged on the floor, all ready to be packed up, various instruments for surveying Mount Sinai: Corporal Goodwin to accompany the expedition to model the hills and general features of the country, inscriptions, &c.; *Corporal Brigly*, to sketch hills; *Corporal Malins*, to survey; *Colour-Serjeant McDonald*, hitherto in charge of the photographic department, chief surveyor and photographer.

Corporal McIntosh, aged 30 (in uniform), working as bookbinder and map-mounter.

The copper-plate printing proceeding under *McLennan* and *McFadden*, late *Serjeants*.

In the hydraulic press-room the Bramah Press, of an unusually large size (pressure 400 tons), for holding and drying elephant sheets of drawing-paper, superintended by *Mr.*, late *Serjeant-Major*, *Boyle*, aged 59, entirely constructed from his own model by *Corporal McLintock*, also the inventor and the maker of a large ruling machine beautifully ruling on copper plates lines so close to each other, that when printed they have the appearance of an Indian ink tint. In this manner houses, sand, mud, and parks are quickly and beautifully designated.

The officers of foreign nations who have visited the Southampton Establishment, I was informed, have greatly admired this instrument, the only one of its kind at present in existence.

Upon these plates, trees forming shrubberies, woods, and forests, stamped mechanically by small spring punches, thereby causing an almost incalculable saving of expense; in fact, I was informed that what would require six months' hard labour is thus executed in less than a fortnight.

By means of a machine provided with scales, graduated in the finest manner, *Colour-Serjeant Brider* was laying down the marginal lines, trigonometrical points, latitudes and longitudes, on the

copper-plate, which is then ready for the engraver to fill in the details.

Six galvanic batteries at work (superintended by a non-commissioned officer) for making electrotype fac-similes of the engraved copper-plates.

Serjeant-Major Spencer, my attendant, superintends (under an officer) the zincographic tracing and printing departments.

Serjeant Toop, aged 33, superintending the colouring department, and examination of proof impressions from the copper-plate.

Sapper T. Jones, an ingenious gas-fitter, and good compositor.

Quartermaster Steel, enlisted as a miner, and who came from Chatham to the Trigonometrical Survey, after being employed on the principal triangulation was appointed to make the measurement of the base-line on Salisbury Plain, with General Colby's compensation apparatus,—a task, I was informed, he accomplished with such admirable accuracy that its measured length differs only five inches from the length, as computed throughout the triangulation from the base at Lough Foyle in the north of Ireland; afterwards he observed the latitudes of nearly all the astronomical stations in Great Britain with Airy's Zenith Sector. More recently, Quartermaster Steel has been employed in conjunction with *Serjeants Compton* and *Buckle*, two excellent observers, in tracing out by means of astronomical observations

of latitude and the direction of the meridian, an extraordinary disturbance of the direction of gravity in a portion of Banffshire and Aberdeenshire.

Had Banff been plotted on the map from its observed latitude it would, I was informed, have been 1000 feet out of its position, caused by what is conjectured to be either an immense cavity in the earth's crust or a subterranean mass of unusual density in the vicinity of that town, detected by Serjeants Steel, Compton, and Buckle (while ascertaining by means of a modern and exceedingly accurate instrument called the Zenith Telescope, the latitudes of a number of places in Scotland), by observing that in the locality in question, their plumb-line did not hang perpendicularly; and as all buildings in that portion of Banffshire and Aberdeenshire have been erected by the plumb-line, it is an extraordinary fact that throughout that sedate region there does not exist an upright building, nor an upright man, woman, or child; all,—including ministers of all persuasions, and politicians of all denominations,—partaking of this recently-discovered inclination of the plumb-line.

Quartermaster-Serjeant Shearer conducts the military correspondence; he also disburses, I was informed, with his own hands, in payments almost entirely in wages, about 15,000*l.* a year.

Corporal Fogarty in charge of the letter-press printing.

Colour-Serjeant Downing in charge of the meteorological department, moreover Clerk of the Works.

In fact, all the departments in the great establishment at Southampton (excepting the engraving) under Engineer officers, are superintended by non-commissioned officers of the corps.

At the present moment there are, I was informed, sappers in charge of instruments and of hired civil assistants and labourers in various parts of the country at great distances from the head-quarters of the divisions to which they belong. And as a general rule, whenever and wherever the non-commissioned officer, from illness or otherwise, is absent from his survey duties, the senior *sapper* takes charge pro tempore—pays the party, however large.

At head-quarters at least three of the non-commissioned officers in charge, I was told, disburse with their own hands upwards of 1000*l.* a quarter, principally in wages.

The whole of the non-commissioned officers commanded by my conductor, Serjeant-Major Spencer, aged 46, of whose high attainments, classical as well as engineering, I can vouch.

A few figures will demonstrate the importance and extent of the scientific duties which Sir Henry James so ably superintends.

Four years ago (I copy from my note-book) after finishing the survey of Ireland and six nor-

thern counties of England, and some of the southern counties of Scotland, an estimate was submitted by Sir Henry James for the completion of the cadastral survey of the whole kingdom, amounting to 1,850,000*l.*, which was readily approved of by both governments, whigs, and tories.

This year, after the rate of 88,345*l.* a year for four years, making 353,380*l.*, Parliament has granted an additional expenditure of 30,000*l.* a year, in order that the survey may be finished in fifteen or sixteen years, making an annual expenditure of 118,345*l.* a year for the completion of the survey.

The result of the survey in Ireland has been to produce an increase in the revenue, according to the testimony of Sir Richard Griffiths, in Ireland of 250,000*l.* a year.

The application of photography introduced by Sir H. James in 1855 will, it is calculated, save at least 35,000*l.* in the course of the survey.

By photozincography, also perfected by Sir H. James and Captain * * *, R.E., in 1859, *sappers* have been enabled to make fac-similes of 'Doomsday Book,' now published at a profit, and of a selection from the National Manuscripts of England and Scotland.

The researches of The Palestine Exploration Fund (a Society for the Accurate and Systematic Investigation of the Archæology, Topography, Geology, and Physical Geography, Natural History,

Manners and Customs of the Holy Land, for Biblical Illustration, patronised by Her Majesty the Queen, with a committee of 77 members), have been entrusted to a party (under an engineer officer), consisting of *Serjeant Birtles* and 3 *sappers*.

The managers of the Photographic Office are *Colour-Serjeant McDonald* and *Corporal Hackett*, R.E.

Throughout Great Britain and Ireland, not less than 100 parties of surveyors are, I was informed, scattered over the country, each under the charge of a non-commissioned officer of sappers: many at this moment encamped on mountains in the most exposed situations; some performing astronomical observations.

During the last Session of Parliament, Sir H. James was suddenly called upon by Government to produce plans of every county divided under the Reform Act, and of every borough of England and Wales; and to print, for Members of Parliament and others, 2032 copies of 261 plans, making a total of 530,352 plans, every one of which had to be coloured by hand.

The above plans all zincographed by or under the superintendence of non-commissioned officers and sappers, were executed in less than two months.

The photographic transfers for the photozincographic edition of 'Doomsday Book' were taken

by *Corporals Rider, Cousens, Hackett*, and by *Sapper Preston.*

Corporal Hackett is now engaged in photozincographing the fac-similes of a selected series of the National Records of England and Scotland.

Having supplied the reader with figures just as they were given to me, and with facts just as I witnessed them at Southampton, without the intrusion of any opinion of my own, I leave him to consider, and, after due reflection, to determine for himself, whether the money expended on the education of "the Sapper" at the Royal Engineer Establishment at Chatham has or has not been productive of adequate scientific results.

I cannot, however, quit our great National Engineering Establishment at Southampton without also submitting for the reader's consideration the following extraordinary statement, which I regret to say affords another striking example of the manner in which Science, in whatever garb she appears in the British service, is discountenanced by what, with due delicacy, is impersonally termed "*the War Authorities.*"

In 1860, General de Blaramberg, formerly Director of the Russian Imperial Survey, having been permitted to take notes of the Royal Engineer Establishment at Southampton, on his return to Russia erected at St. Petersburg a photographic building similar to that designed by Sir H. James.

A few months ago, Lieutenant Elagin, of the Russian Navy, on a similar visit, obtained information on all branches of the English Survey. The Directors of the Swedish Survey and of the Spanish Survey also went over the whole establishment, and Lieutenant-Colonel De Zea and two officers of the Spanish army, after studying in it the photo-zincographic process, made so favourable a report of the process that the Spanish Government conferred upon Sir Henry James and Captain Scott, R.E., the order of Isabel la Católica.

The Establishment has also been visited by General Baron von Moltke, Chief of the Staff of the Prussian Army; by Major-General Hazelius, Chief of the Topographical Department of the Swedish Army; Colonel Ibañez, who superintends the great triangulation of Spain; Colonel Zimmerman, Chief of the Topographical Department of Prussia, who came in September last to learn the mode in which the British Ordnance Survey made a Cadastral Survey, with the view of trying the same system in Prussia. In fact, officers, I was informed, of all the Governments of Europe have come to the British Engineering Establishment at Southampton where by Sir H. James's orders they have been, and are not only allowed to see everything, but every facility is given to them to gain and carry away whatever information they desire.

The testimony of the French Government is as follows:—

"RAPPORT DE LA COMMISSION MILITAIRE SUR L'EXPOSITION UNIVERSELLE DE 1867.

"*Géodésie et Typographie, Cartes Géographiques*, Page 265.—"Il est à peine nécessaire de faire ressortir l'importance de l'œuvre poursuivie par l'Ordnance Survey, œuvre sans précédent et qui devrait servir de modèle à toutes les nations civilisées."

And now, how inexplicable is the fact (no one directly or indirectly suggested it to me), that this Southampton National Establishment—visited by engineers of all countries of Europe; executing a great work estimated to cost 1,850,000*l.*; which at this moment is expending 118,345*l.* per annum; which has divisional stations at Tunbridge, Aberdeen, Oban, Banff, Guildford, Inverness, London, Chester, Edinburgh, Dublin; superintended by 1 colonel, 1 lieutenant-colonel, 14 captains, 2 lieutenants, 1 quartermaster, and 362 non-commissioned officers and sappers, the latter even at Jerusalem wearing the British uniform—should by the War Authorities of England, simply because the Establishment is "scientific," *be excluded from 'the Army List,'* which, dated War-Office, is reprinted monthly

"BY AUTHORITY"!

And accordingly, if a Committee of men of Science, despatched to England with orders to examine and report on the military establishments

of Great Britain, were to purchase as their 'Guide-book' Her Britannic Majesty's 'Army List,' they would by it be led to the War-Office, the Horse-Guards,

The Departments of—Adjutant-General; Chaplain-General; Quartermaster-General; Paymaster-General; Commissary-General; Judge-Advocate-General.

The Colleges and Schools of Instruction at Brompton Barracks; Cadets (Woolwich); Musketry (Hythe); Cadets and Staff (Sandhurst).

Hospitals:—The Herbert; the Royal Victoria.

The Cavalry Depôt (Canterbury); the Recruiting Depôt; ditto for Reserve Forces; and other establishments;

and having been liberally permitted to visit the whole of the above, they would leave England perfectly unconscious that, lying latent at Southampton, and overlooked by them, there existed the most costly scientific military engineering establishment on the surface of the globe!

But supposing, what undoubtedly would have been the case, that having heard of the name of Colonel Sir Henry James, they had especially looked out for *his* department, they would have found in the 'Army List' (*see* p. 161):—

"Topographical Branch, 4, New street, Spring Gardens:—
"Director, Colonel Sir Henry James, R. Eng.
"Executive Officer, Lieut.-Colonel Cooke, C.B., R. Eng.
"Assistant, 2nd Captain J. T. Barrington, R.A."

But the main object and duties of *this* department (which, though it happens to be under the direction of Sir Henry James, is *not* "the Ordnance

Survey Department") simply consists in obtaining topographical and statistical information respecting all the armies of foreign nations which may be of service to Her Majesty's Government.

In its office there is accordingly kept a collection of the best maps of all the countries in the world, whether published by their Governments or by private publishers, Her Majesty's Government interchanging with other Governments the maps they respectively publish. On the commencement of the Abyssinian war a collection made by this office of extracts from the works of all Abyssinian travellers, and published at the Stationery Office, gave Her Majesty's Government such valuable information that Lord Stanley in the House of Commons enumerated it as one of the reasons which had enabled his colleagues to determine to engage in the Abyssinian war, in support of which two thousand copies of the pamphlet issued from this topographical office were printed and presented to both Houses of Parliament.

Having, I trust, fairly described the value and importance of this office, I must with equal fairness state that its establishment — composed of 3 officers, 1 serjeant, R.E., 2 sapper clerks, 10 draughtsmen, 5 lithographic printers, 1 collector of statistics, and 7 labourers, (total, 29), all comprehended in the little offices in Spring Gardens—as compared with that of the Royal Engineer Survey Establishment at Southampton employing 19

officers and 4 companies of Royal Engineers, consisting of 90 non-commissioned officers, 272 sappers, 668 civil assistants, and 499 labourers, (total 1548), in number of persons employed and in area of operations, bear about the same relation to each other as a nobleman's park does to the great county of which it is a part.

Why, therefore, it will gravely be asked, in Her Majesty's 'Army List,' is the small topographical establishment in New Street, Spring Gardens, *in*cluded, and the large National Engineering Establishment at Southampton *ex*cluded?

I attribute motives to no one; but in answer to the above most important question I simply submit to the reader, without a word of comment, as a fact, that the large establishment at Southampton (see Appendix E) is conducted throughout all its details and throughout its immense area by Royal Engineer officers and sappers, whereas the tiny topographical department, by order of the War Authorities, is directed by

1 Cavalry Officer, or
1 Officer of the Line,
1 Officer of Royal Artillery,
1 Officer of Royal Engineers,

the whole, at present, being under the able direction of Colonel Sir Henry James, residing at Southampton.

In the United Kingdom, and throughout all our colonies, "the sapper" has to perform duties more

or less scientific, which it would be both difficult and tedious to enumerate.*

In the Crimea, in conducting the troops after dark to the trenches, the word of command was always, "*Follow the sapper,—Quick march,*" a sapper being always in front. From its frequent use the term became a cant word amongst the line soldiers to express any dashing or hazardous service. Thus, when, on guard in the trenches, they were ordered up to drive in a Russian sortie, as they jumped over the parapet their cry "Follow the sapper!" always received with cheering and laughter, was considered amongst the men a very good joke. In fact, these noble fellows feel so thoroughly mystified and confused by the intricate proceedings in the trenches, that it is quite a relief to them to have a plainly-understood stand-up fight, be it in daylight, twilight, or darkness.

While carrying on a sap on the side of the steep hill at Burgos, parallel and so close to the line of the enemy that he turned over live shells into its trench *from a scoop at the end of a long pole*, giving for his own sake a little extra length to their fuzes, our sappers *shovelled* them over the reverse of the trench to roll down the hill, and then proceeded with their work.

Having shown, by figures and facts, what a scientific education has done for the sapper, there remains to be answered—What has it done for

* At St. Helena two sappers made Napoleon's grave, two others lowered into it his body, and others refilled it.

"the Royal Engineer"? or, in other words, what is the precise difference in value between the raw candidate for enlistment at Woolwich as a cadet, and the article when turned out, about four years afterwards, from the Royal Engineer Establishment at Chatham in the manufactured state?

Now, as regards this important question, instead of intruding upon the reader any opinion of my own, I beg leave to submit for his own judgment the following plain statement.

In the commercial world it has long been admitted as an axiom "that the true value of a thing is what it will fetch in the market."

"Show us therefore," it may justly be said, "what is the appraisement of *the public*, from the very highest class down to the lowest, of the market value of the educated article in question."

The facts are simply as follows:—

In Her Majesty's 'Army List' for the present month, the names of 48 lieutenants of Engineers, 5 2nd captains, 21 1st captains, 13 lieut.-colonels, and 1 colonel, (total 88), being more than one-sixth of the whole corps, are printed in italics, to make known that these *Italicised* officers have been, by authority, abstracted from the duties of their corps to perform especial duties (as will be shown) for the Crown, for almost all the departments of Her Majesty's Government, for public bodies, and even for private individuals.

The following selections will show the nature of the extra duties which "the Royal Engineer" has

been required to perform, with the names of the authorities that have required them to be performed.

1. Among the sovereigns throughout the world there has rarely existed one more intellectual, more sound in judgment, and further sighted than the late Prince Consort.

On no subject could he have more deeply reflected than how to give to three adolescent sons the best possible education.

On resolving that each should be attended by some trustworthy person, he had of course before him an array of clever men of all ages, who at our universities had been distinguished by learning, and in after life by sound, moral, and religious principles.

He took all into consideration, and his cool calm deliberation ended in his applying to the corps of Royal Engineers, who successively "told off" for the delicate and difficult duties required to be performed, three young lieutenants (one has earned the Victoria Cross), of whom, refraining from the smallest amount of praise, I will simply affirm that they have given satisfaction to all parties.

2. On the 10th of May, 1811, Lieut.-Colonel Reid, R.E., was wounded in a knee. On the 19th of January, 1812, in a leg. In leading the assault of St. Sebastian he was *shot through the neck.*

Twenty-three years afterwards, on the 5th of May, 1836, before the very same place, St. Sebastian,

he was again *shot through the neck*, and when Peace, putting him in irons, prevented him from fighting or storming, while he was Lieutenant-Governor of Bermuda, out burst from his brain a most valuable volume on the 'Law of *Storms*.'

And just at that time out oozed from the calm cool brain of the Prince Consort a project, the invention and success of which will live in history as one of the noblest children of Science.

Now everybody would have guessed that to enable him to carry out before the world "an idea" which many sycophants who openly extolled it secretly believed would be a failure, he would have required the assistance of some philosopher competent to appreciate and arrange its innumerable scientific details.

In his difficulty, however, the Prince Consort, on due reflection, decided not only to repair for the fourth time to the corps of Royal Engineers, but by his own selection, Lieutenant-Colonel Reid, of storming notoriety, but whose mild, calm, clear judgment was equally well known, suddenly found himself snugly sheltered from the slightest breeze of air,—governor and commander-in-chief, or rather the sovereign, of a glass palace, in the intricate management of which, as well as of its contents, he was supported by 12 Engineer officers, and, instead of a body of trained London police, by a party of 200 educated sappers.

In the Exhibition of 1862 there were employed

under Captain Fowke, R.E., 6 officers and 90 sappers. In the demolition of its great brick arches in 1864, 1 officer and 18 sappers.

3. Without troubling the reader with unnecessary details, I will briefly add that from the corps of Royal Engineers have been selected :—

1 Lieutenant to be Secretary to a Prime Minister, and afterwards Secretary for Ireland.
1 Permanent Secretary of State for Ireland.
1 Lieutenant to be Lieut.-Governor of the Falkland Islands.
3 Officers for the Museum of Science and Art at Kensington.
1 Secretary to the British Commission for the Paris Exhibition of 1855.
4 Ditto for the Royal Military and Staff Colleges, Sandhurst.
1 Government Inspector of Roads in Wales.
3 Ditto as Superintendents of Works, Admiralty.
2 Ditto, Board of Trade.
1 Control Department.
4 Government Inspectors of Railways.
1 Inspector-General of Prisons.
1 Inspector of Prisons.
1 Master of the Mint in New South Wales.
1 Ditto ditto in Victoria.
1 HM. Commissioner of Navigation of Danube.
1 Telegraphs, Persia.
1 H.M. Consul-General and Agent, Egypt.
1 Exploring at Jerusalem.
1 Governor of Straits Settlement.
1 Specially employed in China.
1 Public Works in India.
1 Created by the Emperor of China one of his 17 Mandarins.
1 Adviser to the Turkish Government.
1 Field Marshal, Constable of the Tower.
1 For a short period Governor-General of India.
1 Governor of Madras. (Also many other Governors of Colonies.)
15 War Office.
6 Horse Guards, &c. &c. &c.

Now, without a word of comment upon the above, I will proceed at once to the following dialogue :—

"Well! the Royal Engineer is certainly a man of all work, but how about his *fighting?*"

Answer: It has been distinctly stated that he is no 'hero;' his duty being confined to directing, conducting, and leading 'heroes of the line' to some of their glorious duties.

Question 2: "If then he merely leads without fighting, what is the amount of danger which *he* can possibly incur?"

Answer: The following extracts from 'Journal of the Sieges in Spain,' by Major-General Sir John T. Jones, Bart., K.C.B., will accurately reply to that question :—

No. 1. (Vol. i., page 154.)

SIEGE OF BADAJOZ, 1812.

(*Officers present throughout the Siege.*)

Lieutenant-Colonel Fletcher, C mmanding.
Major Squire, Director.
Major Burgoyne, ditto.
Captain Ellicombe.
Lieutenant Gipps—wounded.
Major M'Leod—wounded.
Lieutenant Elliott—wounded.
Captain Nicholas—mortally wounded
Lieutenant Emmett—wounded.
Captain Williams—wounded.
Lieutenant de Salaberry—killed.
Captain Holloway—wounded.

Lieutenant Stanway.
Captain Mulcaster—killed.
Lieutenant Melhuish—wounded.
Captain Wedekind.
Lieutenant Lascelles—killed.
Lieutenant Wright.
Lieutenant Reid.

No. 2. (Vol. ii., page 19.)

ST. SEBASTIAN, FIRST SIEGE, JULY, 1813.

The ENGINEER'S MEANS *available for this attack were :—*

OFFICERS.

Lieut.-Colonel Sir R. Fletcher, Bart., Commanding—killed, (shot through the heart).
Lieut.-Colonel J. F. Burgoyne—wounded.
Captain George Henderson.
„ Charles Rhodes—killed.
„ C. G. Ellicombe, Brevet Major.
„ C. F. Smith, Brevet Major.
„ G. G. Lewis—badly wounded.
„ Richard Boteler.
„ George Collyer—killed.
Lieutenant F. Stanway.
„ H. D. Jones—severely wounded and taken prisoner.
„ A. Marshall—wounded.
„ Philip Barry—wounded.
„ H. A. Tapp—wounded.
„ W. Reid—wounded.
„ E. Matson.
„ L. Machell—killed.
„ H. Wortham.

The records of the Horse-Guards and War-Office can demonstrate that in the wars of the Peninsula, France, and the Crimea, including the battles of Waterloo, Alma, and Inkerman, no one fighting

regiment in the British service, in any battle or assault, ever had so large a proportion of its officers killed and wounded as are recorded in the above two lists of the losses of the "Hero"-less corps of Royal Engineers.

In the late Eastern war the total number of casualties of officers, non-commissioned officers, and men of the Royal Engineers were 550 out of 1644.

At the storming of Magdala the only two officers wounded (slightly) were Engineers.

Question 3: "For Staff appointments in time of war *riding* is a primary qualification. Is it possible for a dealer in electricity, photography, printing, torpedoes, flashing signals, and fog-horns, to carry orders safely across *rough* ground? Show us therefore what your 'Royal Engineer' is *on pig-skin*."

Answer: Those who are curious to know exactly how he sits on his saddle, have only to look at him as he sits photographed in this volume.

How he can ride across rough country will be best explained by the following fact:—

From the 'Correct Card, printed and published *by authority*, of the Aldershot Divisional Steeple-chase Meeting, 1868,' now before me, it appears that of twelve steeplechases run on the 21st and 22nd April last, by officers of the Staff, Cavalry, Line, Artillery, and Engineers, six of the horses that came in first were ridden by Engineer officers (two of them were subsequently disqualified for

having passed the wrong side of one of the posts which marked the course).

Question 4 : "As the Royal Engineer is ignorant of battalion drill, does it not logically follow that he must be incompetent to command a division of an army, even at a review, and, *à fortiori*, in the field?"

Answer: Yes. Nevertheless,

1. In 1863, after the Tai-ping rebellion had raged for ten years, the Chinese, dissatisfied with the officers who had previously held the command of their army, having applied to the British authorities for a General, Sir Charles Staveley recommended to them Major Charles Gordon, R.E. This young officer (aged 29) had not British troops to operate with against Chinese rebels. He fought with Chinese against Chinese. He had to make the tools with which he gained his victories, and in this he was assisted by a few foreigners — English, German, French, but principally Americans—most of them reckless adventurers of the seafaring profession, and some ready without compunction to take either side.

In fourteen months, as General-in-Chief, he extinguished the rebellion. An Engineer officer of distinction, now dead, in a private letter before me, wrote:—

"Charlie Gordon has gained more battles in the field, taken more cities, more men have laid down their arms to him, than any British General living."

Major Gordon was lent to the Chinese Government. His sovereign, for the time being, was the Emperor of China, and not the Queen of England. By the former he has been as highly exalted as Lord Napier of Magdala has by the latter. By the Emperor he was created Admiral and General-in-Chief of one of the eighteen provinces in China. Out of a population of 300,000,000 he was made, and now is, one of their seventeen mandarins of the 1st Class, with the Order of the Yellow Jacket. On being, however, offered by the Emperor, in addition to his pay while serving, 10,000*l.* as a recompense for his services to foreigners; he declined to receive it. A poor man he went out; he came home poorer, and although by acclamation he is considered as the most brilliant young officer in the corps of Royal Engineers, as also one of the most humble-minded, England has made him no richer, and yet his conduct in battle, and in all the operations of war, will stand comparison with that of any man.

Well did the 'Times,' in one of its able articles, state:—

"Never did soldier of fortune deport himself with a nicer sense of military honour, with more gallantry against the resisting, with more mercy towards the vanquished, and with more disinterested neglect of opportunities of personal advantage, than this young officer who has just laid down his sword."

2. In 1836, in Sir De Lacy Evans's great battle

before St. Sebastian, the late Sir William Reid, R.E., as a Brigadier-General, commanded the Light Brigade of the Legion, of which he was also Quartermaster-General.

"Sir William Reid was highly spoken of as a first-rate Commander and Staff-Officer by all ranks of the Legion." —*Extract of a Letter from General ——, V.C., C.B.*

In 1846 Colonel Sir Charles Felix Smith, R.E., commanded the allied land forces at the bombardment and surrender of Beyrout, and at the capture of St. Jean d'Acre.

3. In 1844 Colonel, now Major-General Simmons, R.E., late Consul-General at Warsaw, commanded a Turkish army of 20,000 men. Omar Pacha, in his despatch, attributed his success at the passage of the Ingur River chiefly to Colonel Simmons's movement.

4. Lieutenant-Colonel Sir T. Cheape, R.E., commanded a division in the second Burmese war.

5. Lord Napier of Magdala.

6. The following is a list of Engineer Generals of other nations who have been distinguished commanders of troops:—

FRENCH.

CAVAIGNAC (promoted from Captain of Engineers into the Line), won Paris from the Reds in 1848.

NIEL, who commanded a corps at Solferino, now War Minister of Napoleon III.

VAILLANT.—Chief of the Staff to Napoleon III. in the campaign of 1859.

TURKISH.

OMAR PACHA.—An Engineer cadet in the Austrian service.

AMERICAN.

Generals ROBERT LEE, BEAUREGARD, SYDNEY JOHNSTONE } Southern Commanders-in-Chief.

MEADE.—Federal Commander-in-Chief.

WARREN.—Chief Engineer to Meade. At Gettysburg was made head of an army corps, and soon after won a brilliant rear-guard action.

WRIGHT.—Head of a large army corps in 1864-5.

WILSON.—Promoted from lieutenant of Engineers to command a corps in eighteen months. His advance cut off Jefferson Davis's escape.

Having submitted to the reader data sufficient, I believe, to enable him to judge and decide for himself what are the results of the three educations which English Engineer officers are required to undergo, and what are the positions which they and officers of the same corps in other countries respectively attain, I venture to point out as a remarkable fact that while in foreign countries Engineer officers, on account of their scientific acquirements, have been openly *selected* to command armies and to hold high Staff appointments, English Engineers for the very same reason (with the exception of Lord Napier of Magdala), although they have been permitted to command the foreign armies of the Emperor of China and the Sultan of Turkey, &c., yet have virtually been excluded from the direct command of any large British

army in Europe or America, or even of any garrison large or small.

Again, as regards the important appointment of Quartermaster-General to an army in the field, the rule of the British War Authorities, as compared with the practice of all other civilised nations, is so eccentric and so serious an error that I venture to submit to the reader the following observations thereon.

No one can have read Lord Napier's late despatches reporting the progress of his army from Zoulla to Magdala without being reminded that after the nomination of the General-in-Chief the most important duty which, in preparing an expedition for service in the field, be it offensive, defensive, or both, a War Minister has to perform, is the selection of its Quartermaster-General, a portion only of whose duties are very clearly defined in the following extract from "THE QUEEN'S REGULATIONS FOR THE ARMY," printed annually and (for the present year) dated "Horse-Guards, 1st January, 1868":—

"*Quartermaster-General's Department.*

"The officers of this Department are required to have a perfect knowledge of the state of the roads, and the features of the country applicable to defence, also of the course of rivers, and the power of inundations. In coast districts they are further to possess accurate information of practicable points of landing, the best positions for defence in their immediate vicinity, and the particular winds and

periods of tide that afford an enemy facility in approaching the coast."

In addition to the above the Quartermaster-General's especial duty is to make for the General commanding and for the guidance of subordinate officers, maps and contour plans of the seat of war, and occasionally, as in Abyssinia, to make and repair roads and bridges for the passage of the army, and also, in taking quarters, to ascertain what number of men the beams and rafters of upper stories can safely sustain, &c., &c.

Now the obvious disadvantage of the English old and still existing system is that in time of peace the Quartermaster-General's department, from sheer want of practice, gains little or no experience, and thus on the sudden breaking out of a war an inevitable catastrophe ensues.

Whereas if the duties of this department were by the decree of Parliament to be inflicted upon the Royal Engineers (of course under the sole direction of the Commander-in-Chief) the corps, by its never-ceasing practice, at an instant's warning, would be competent not only to supply the particular description of officers qualified for any and every particular description of service, such, for instance, as good riders, expert water-borers, experienced road and bridge makers, surveyors, draughtsmen, signallers, &c., but to despatch them, accompanied by well-organised field-trains, electric telegraph men and sappers, especially selected for

the particular services required. To collect together all these ready-made preparations could be effected promptly by a single telegraphic order from the Horse-Guards.

Now, even supposing that the Quartermaster-General's department, resolving under the old system to repudiate the intervention of modern science, were to obtain counter authority from Parliament to educate and maintain a body of officers and men equal in experience as workmen to those of the Royal Engineers, British taxpayers in general, and their army in the field in particular, would suffer severely from services of the same character being subdivided into different branches, the one at times being possibly greatly in want of officers, workmen, and tools which the other could readily supply. And even supposing that both services, which is not very probable, worked as harmoniously together as do the Horse-Guards and War Office, yet it must surely be evident to all people that two departments obtaining assistance from each other is not only a violation of the fundamental principle of military discipline, but is practically far less effective than when all the component parts of each by word of command act under the same direction, control, and instruction. In fact it would be as preposterous for the Quartermaster-General's department and the Engineer department each to carry an equipment of officers, artificers, tools, and stores, as

it would be to divide the medical department into two branches; the one, in time of action, to superintend the heads, arms, and necks of the troops engaged; the other, their legs and bodies. Now unless the newly-made Parliament firmly and peremptorily declares that the advance of an English army in the field shall no longer be liable at any moment to halt between the two opinions or systems that at present exist, the English taxpayer at considerable expense is educating, fostering, and maintaining in Brompton Barracks *Science* which at the critical instant it is wanted is cast aside.

In the meanwhile, it may be stated not only that no officer of Engineers has ever been selected as competent to perform the important scientific duties of Quartermaster-General to a British army in the field; but that in 1851, on General Sir Harry Smith during the intricacies and difficulties of the Caffre War, deeming it advisable for the public service to avail himself of the education and professional experience of Lieutenants Jesse and Stokes, R.E., appointed those two officers by a General Order to be the Deputy Quartermaster-Generals of the army he commanded. So soon, however, as these appointments reached England, an order was despatched from the Horse-Guards peremptorily desiring that the two Engineer officers should be directed to return to their duties, and that two officers of the Line should be ap-

pointed by Sir Harry Smith to act as Deputy Quartermaster-Generals in their stead.

Now as a most extraordinary, and, I regret to add, humiliating contrast to the above ruinous system of educating at great expense a corps of Engineers, and then jealously repudiating the fruits of its education as worthless, I beg leave to submit to the reader the following official evidence, showing the precise practical value of the same corps, as endorsed by the Secretary of War for the United States on the conclusion of the most costly, sanguinary, desolating war recorded in the military annals of this world:—

REPORT

Of the CHIEF ENGINEER *of the* UNITED STATES ARMY *to the* SECRETARY OF WAR. *For the Year ending June 30th,* 1865.

"*Engineer Department.*
"*Washington, October* 30, 1865.

"SIR,

"I have the honour to present the following Report upon the several branches of the public service committed to the care of this department for the year ending on the 30th of June, 1865:—

"*Corps of Engineers.*

"Of the eighty-five (85) officers of Engineers embraced in the corps, fifty-four (54) were on detached duty commanding army corps, divisions, and other military organizations, on Staff duty, and as engineers and assistant-engineers with armies operating against the rebels, in command of the pontoon bridge service, and in command of the troops of the engineer battalion; and thirty-one (31) on duty superintending sea-

coast defences, lake surveys, lake and sea-coast harbour improvements, military academy, and assisting the Chief Engineer in connection with all these duties.

"Every officer of the corps has been on continued and uninterrupted duty during the entire year."

As the writer of the above document styles himself very correctly "*Chief Engineer of the United States Army*," and as in every French army the same description of officer is honoured by the appellation "*Chef du Génie*," the reader will naturally infer that the General officer, who in the British service is simultaneously the chief of the whole Engineer force through Great Britain, Ireland, all our Colonies, and armies in the field, should be honoured by bearing, before the world, the same high title.

The sad truth, however, is, that although in the Army List are emblazoned the titles of

"Chaplain-*General*," "Commissary-*General* in *Chief*," "Director-*General* Medical Department," "Purveyor in *Chief*," "Accountant *General*," "Comptroller in *Chief*," "Paymaster *General*," "Judge Advocate *General*," "Inspector *General* of Military Prisons," "Commandant and Inspector-*General* of the School of Gunnery," "Colonel Commandant Inspector-*General* of Recruiting," (with a long list of subordinates styled in military anti-scientific grammar "Deputy Assistant Adjutant-*Generals*," "Quartermaster-*Generals*," and "Commissary-*Generals*," meaning thereby that they are the Deputy Assistants of the Adjutant-General, of the Quartermaster-General, and of the Commissary-General; just as a young Staff officer is styled "the General's Aide-de-Camp," and not the Aide-de-Camp General, and just as the bare-headed, bare-footed, haughty little Highland boy styled himself the 'Duke of Argyll's fiddler's son's wee laddie,' and not 'the fiddler's son's wee laddie, *Duke of Argyll*');

I repeat that although in the 'Army List' all these names are emblazoned, in its page 161, published by authority, and headed "WAR OFFICE, Pall Mall, S.W." (not in that headed Horse-Guards) the Chief Engineer of the British service and other distinguished officers of the same corps are thus designated—

Director of Works—Major-General Edward Frome, Royal Engineers;

Director (Topographical Branch)—Colonel Sir Henry James, R.E.;

Executive Officer—Lieut.-Colonel Cooke, C.B., R.E.;

Director (Royal Engineer Establishment, p. 121)—Major-General J. A. Simmons, C.B., R.E.;

it is devoutly to be hoped that the New Parliament, on behalf of military *Science*, will not allow her representatives in the British army to be publicly degraded before the military nations of Europe by civil or rather uncivil nicknames which refrain from stating whether England's "CHIEF ENGINEER" and his officers are "*Directors*" of water, gas, fire, day, or night "*works*."

The impolicy of the British War Authorities in thus degrading officers of Engineers in the opinion of the soldiers of the Line, will appear from the following extract from the published 'Military Opinions by General Sir John Burgoyne, G.C.B. 1859.'

"The unmilitary light in which the working parties (in the trenches) are looked upon in our service is very unfortunate. A working-party at a siege seems to be held in the same consideration as one to clean out a barrack." —p. 287.

Having, as in my Preface I volunteered to do, submitted to the general reader an impartial sketch of "what Military Science *is*," I will now endeavour to execute the opposite task of demonstrating by facts and evidence, which I believe to be incontrovertible, "what is *not* Military Science."

PART III.

THE OBSOLETE SYSTEM OF WAR.

"C'est magnifique, mais ce n'est pas la guerre."
(*General Canrobert's remark to General Sir John Burgoyne.*)

I DO not see dimly what I have undertaken to express, but the difficulty that meets me on the threshold is, how to avoid commencing my speech to my reader by the words—

"We *are* indeed a remarkable people!"

Suppressing, therefore, my opinion on this subject, I will only allow myself to say that throughout a very long life I have observed and appreciated the character of the Anglo-Saxon on both sides of the Atlantic, and that I have been, and am, an enthusiastic admirer of the British soldier.

The glorious ideas embodied in the two words "ALMA" and "INKERMAN," the one in military grammar the active, the other the passive verb, constitute a character nobly delineated by a French officer of high distinction as follows:—

"*Our* men," said General Canrobert in the Crimea "can make the most brilliant rushes on an enemy, but *you* (English) coolly walk up to them."

Now this fact, for such it is, is the effect of three causes:—1st. The innate cold courage of British soldiers. 2nd. The brave, gentleman-like bearing of their officers. 3rd. The admirable discipline

that has welded the innumerable but not identical particles of courage in the component parts of a regiment into *one solid mass.*

I believe that these three causes are known and appreciated by the troops of all nations.

I believe that at no period of the military history of England has the discipline of the British army ranked higher in the scale of perfection than at this moment; and, consequently, it is a fact and not a compliment to assert, that the credit of this present state of discipline belongs to His Royal Highness the Commander-in-Chief; and I cannot but add that the clear, soldier-like eloquence with which on every occasion he expresses himself, most especially when he expounds to the army the importance of discipline, the combined dignity and affability of his manner, and his unceasing exertions, form to the country altogether a character of high value. And although, *per contra*, it cannot possibly be denied that what are impersonally termed "the War Authorities" of England, proceed on the principle of elevating what they consider to be the "fighting" branches of the army, and of depressing the scientific root which ought to be permitted to nourish those branches, yet I will now proceed to show that this extraordinary principle is an ancient hereditary evil, which has taken such hold of the English military system, that, as a vessel is occasionally obliged to "scud before a hurricane under bare poles," so is it

impossible for any commander-in-chief, until he be strongly supported by Parliament and by public opinion, all at once to stand against it.

The hereditary evil above referred to, may be said to have been regularly inoculated into modern warfare by Napoleon I., whose enormous armies encouraged him to discard military science.

Firstly, by giving the go-by to permanent fortifications; and secondly, by disdaining the use of field-works.

In short, he fought and conquered by the bullets and bayonets of his "*gros bataillons.*"

This system of ignorance became the rule of war in Europe, and accordingly during Napoleon's twenty years' wars, with the following exceptions, no field-works were used in European battles.

In 1796, Napoleon used them to cover his left, while he attacked Beaulieu in the affair of Montenotte.

In 1805, at Austerlitz, he protected his pivot wing against the left.

In 1807 the Russians defeated Napoleon behind their works at Heilsberg.

In 1812 they also greatly increased the French losses by the aid of their redoubts.

In 1813, at Bautzen, they held their ground until forced to retreat by their right wing, composed of Prussians (who, according to Müffling their historian, affected to despise the use of redoubts), being outflanked.

In the Spanish Peninsular War, the French army never protected itself by field fortifications, and although the great Duke of Wellington, at the commencement of the war, himself framed instructions for the creation of an establishment of entrenching tools to be carried on 100 mules to accompany his army, yet with the exception of the lines of Torres Vedras, he declined or disdained to avail himself of his entrenching tools, engineer officers, sappers and troops for the purpose of protecting his army by field-works, save after the battle of Fuentes d'Honor, when the French having turned him, he threw up field-works to cover his centre, thereby so strengthening his new position, that they were afraid to face it.

It should, however, be observed that as his great battles were all of attack, they were not, generally speaking, available for entrenching, and were accordingly fought, as described by himself in his despatch to Lieut.-General Lord J. William Bentinck, K.B., dated Lesaca, 5th August, 1813:—

"I never saw such fighting as we have had here. It began on the 25th, and, excepting the 29th, when not a shot was fired, we had it every day till the 2nd. The battle of the 20th was fair bludgeon work. Our loss has been severe."

But although the reason for this glorious display of British courage has been, I hope, clearly explained, yet the manner in which field fortification continued to be discarded by the allied armies

in 1815, has even now become so astonishing, and to future generations must appear so inexplicable, that as I happened to have a glimpse of two occasions on which it might have been used to advantage, instead of trusting to a worn-out memory, I will venture to submit to the reader the following short extracts from a rough memorandum written by me as a young lieutenant of Engineers, while the scenes it describes were fresh in my mind :—

"On the 15*th June*, 1815, at about 7 A.M., as I was on the heights above the town of Charleroi, with my theodolite, employed in my usual occupation of surveying the place, I heard a firing of muskets which for some time I considered to be the Prussian troops under review, and on looking towards the Sambre, I saw soldiers on each side apparently firing at each other; however, as I had dined the day before with General Zieten, and had heard nothing of a commencement or expected commencement of hostilities, I could scarcely believe that it was anything but a mock engagement, particularly as I was not very well acquainted with the exact difference between the French and Prussian uniforms. Uncertain of what was really the case, and yet almost sure that the firing I heard was from ball cartridges, I gave up my surveying, and, leisurely descending the hill, entered the town which I suddenly found in the greatest confusion.

"The streets were full of people who now not only appreciated but overrated the danger of their situation.

"Every horse and waggon having been put under requisition, was trotting through the streets laden with military baggage, and as a few wounded soldiers without their stocks, and in every way looking faint and crestfallen, were hurried through the streets on a litter which seemed to jolt them most dreadfully, the women began to

faint and shriek, while the soldiers of the Prussian guard destined or rather ordered to defend the town, calmly looked at the wounded men, and then at each other, as if they were both aware of and ready for the duty and the scenes in which they were shortly to be engaged.

"Away I rode through the town to join, according to orders which I had received, General Zieten. As soon as I passed the great square, I saw a few companies of the Prussians whose orders were "to defend the bridge to the last," and of whom I believe not a man escaped. I found General Zieten on the heights above the town where he remained some time reconnoitring the approach of the French. He then, accompanied by his Staff, bade adieu to the town, and we all cantered into the road which led to Brussels. . . . .

"From having followed General Zieten in all his reconnoitrings, and from having ridden the whole day across a strange country in almost every direction, I had not, nor have I now, any idea where I was; however, when dinner was over, we again mounted our horses, and joined the army which I found drawn up on the plain of Fleurus, a position which was a very strong one, and which had several times been the chosen theatre of two or three desperate engagements. The Prussian army was awaiting General Zieten's arrival, and the men, leaning on their arms on his approach, were called to attention. The line of heights, or rather the upper plain which they occupied, commanded the low country which we had just left, and which now extended beneath us as far as the eye could reach. As General Zieten rode down the ranks, a dead silence and the utmost stiffness and steadiness prevailed. The men appeared to be in high discipline and spirits. They already seemed rested from their march, the sight of their General gave respectful animation to their countenances, and though the

sun had set when they were in the greatest disorder, yet there was twilight enough for them to perceive that they were now assembled in full force, and that they were occupying an advantageous position. . . . . General Zieten had chosen for his head-quarters a small mound of rich earth covered with wheat, the grave of those who had perished in a former battle. A blazing fire was made at the foot of this eminence, and here we all passed the night, the hot air from the embers warming us most delightfully on one side, while the cool night breeze chilled us on the other

During the night we were constantly awakened by mounted orderlies, who came from the advanced pickets to give in their reports; however, as all was well, General Zieten was not disturbed, but, wrapped up in his cloak, he continued to sleep quite soundly, while we, warmed by the fire, and partially sheltered by the standing corn, again and again dropped off to sleep.

"On the morning of the 16th before the dawn began to appear, a burst of trumpets sounded the *reveillé*, which was echoed and re-echoed by the bands of all the various regiments, and in a few moments the Prussian army had risen from its bed, and although the sound of the bugles made conversation useless, yet . . . . .

This sort of scene continued till about twelve o'clock, when, as General Zieten was reconnoitring his position, a detachment from the advanced pickets brought up to him a French General officer (Bourmont) who had voluntarily surrendered himself into their hands.

"Bowing and scraping, he told General Zieten (who stood all the time as still as a statue) that just before he deserted, Napoleon had ordered the position of the Prussian army to be attacked at two o'clock.

"General Zieten, availing himself of this intelligence, instantly commenced preparations for repelling this attack.

"He ordered his artillery to come forward to the ridge or extremity of the upper plain, which overlooked the low country through which the enemy had to advance, and behind these guns on this upper plain, which gradually shelving backwards could not even see the lower ground, he drew up his army in three lines.

"While these arrangements were taking place, a very faint murmuring noise was at regular intervals heard at apparently an immense distance.

"What it was, no one could have determined, for it was neither thunder nor artillery, but it more resembled a groaning of the air itself, or a sort of Eolian aspiration of the letter R.

"The sound rapidly became more distinct, and from 'eur' it became 'pereur,' 'Empereur,' and at last thundering cries of '*Vive l'Empereur!*' distinctly pointed out to us the French army advancing about a couple of miles distant. . . .

"As their columns steadily continued to advance, their artillery soon began to throw their shots home, upon which the whole of the Prussian artillery opened a heavy fire, which they continued with uninterrupted destruction. The French columns received it with great courage, and whenever a shell burst among them, their shouts of '*Vive l'Empereur!*' were redoubled.

"As they approached the ridge, this cheering was repeated in quicker succession, until getting within musket shot, and the first of the Prussian lines having advanced to the ridge, it was completely drowned by the incessant roll of musketry and banging of cannon which on both sides were fired as quickly as they could be loaded.

"After a most desperate resistance, the advanced line of the Prussians yielded to the impetuosity and superior numbers of the French, and giving way they ran to the rear, where those who survived this retreat again formed."

Now the difference between daylight and midnight is no greater than that between the military science which in 1866 led the Prussian army to almost unprecedented victory, and the obstinate ignorance of the dominant system which, on the 16th of June, 1815, was the sole cause of its defeat. For besides a large division of troops who for nearly twenty-four hours were in position on the upper plain of Fleurus, Generals Zieten and Blucher well knew how to command the presence and assistance of every labourer with his shovel and spade from the surrounding villages, who before the French army reached the position of Fleurus could have entrenched the Prussian army in a manner which must inevitably have insured victory to them, defeat to their invaders.

Instead, however, of worshipping military Science, following the example of Napoleon they scorned her, and heavy was the penalty she inflicted upon them for the offence.*

And now as regards the battle of Waterloo, the prominent facts, so far only as they bear upon the particular principle in question, are briefly as follows:—

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* "*Nous les avons joliment arrangés ce jour-là!*" said a young French dragoon to me some months afterwards.

"*Ah! mon fils,*" replied his paralytic old grandmother, sitting in the chimney-corner, "*Mais c'est un mauvais métier que la guerre!*"

[As most people will deem me presumptuous for submitting any statement whatever on this subject, it is necessary I should explain the very slight grounds on which I venture to do so.

For about two months before Napoleon marched from Paris I was employed first at Antwerp and then at Ath, near Waterloo, in teaching at each place about 200 Flemish labourers, besides women, to throw up the field defences I was ordered to construct.

In consequence of my horse having been killed at Fleurus, cut off from General Zieten, and, while on foot, in two instances mistaken by wounded Prussian soldiers for a Frenchman, I was obliged to repair to the British army. By the kind invitation of the commanding Engineer, Colonel (afterwards Sir James) Carmichael-Smyth, I accompanied him from the field of Waterloo to the house chalked for him in the village of that name where he, his Staff, Major Sir George Hoste, R.E., and I, supped and slept. The following morning (the 19th) I rode with him to Brussels.]

The manner in which, on the morning of the 15th of June, 1815, at Charleroi, the Prussian videttes in reply to their usual challenge "*Qui vive?*" were answered "NAPOLEON!" is certainly the most miraculous feat in the military annals of the world. Indeed no one, I believe, can or ever will be able clearly to understand how he could possibly have collected, organised, and marched an army of 120,000 men, with its enormous amount of artillery and stores, from Paris to the outposts of the allied armies of Europe, preventing intelligence of their progress from preceding them!

The Commander-in-Chief of the allied army, however, was apparently well prepared to receive him:—

"At the instance of the Duke of Wellington (writes Captain Conolly, vol. i., p. 230) who requested 'the whole corps of Sappers and Miners' to be sent to Brussels to

join his Grace's force, seven companies of the corps, instructed in their art, were hurried off to Ostend between the 24th March and 10th of June, and distributed with all possible haste to those frontier posts and fortresses in the Netherlands that most required their services. . . . Not less than 20,000 civil labourers, with very strong military parties, were employed on the line of works extending from Ostend to Mons. . . . Hal was the depôt from which the Engineer brigades were equipped. . . . The total of the Engineer establishments with the army in the Netherlands, under the command of about 60 officers of Engineers, amounted to 10 sub-lieutenants and 838 soldiers of the Royal Sappers and Miners, 550 drivers in charge of 160 waggons, pontoon-carriages included, and more than 1000 horses."

Now in addition to the sagacity with which the Duke of Wellington had collected the above strong engineering force, with his usual foresight he had (as will appear from the following extract) nine months previously, made himself thoroughly cognizant of its applicability to entrenching several positions advantageously adapted for a battle-field.

"*Mem. on Defence of Netherlands by the Duke of Wellington, dated Paris 22nd Sept.*, 1814.

"About Nivelle and between that and Binch are many advantageous positions; and * the entrance of the Forêt de Soignies by the high road which leads to Brussels from Binch, Charleroi and Namur would, if worked upon, afford others."—'Gurwood,' xii. p. 129.

* *This entrance of the Forêt, by the Charleroi Road, is the Waterloo battle-field. Again visited by the Duke of Wellington on the 16th June, 1815.*

From the above it appears that there are *given*—

1st. The defensible position of Waterloo:

2nd. Abundant amount of engineering force:

3rd. Abundant amount of time, *i.e.* the whole of the 17th on which the greater portion of the British army, after their successful resistance on the previous day at Quatre Bras, remained without fighting.

On the 18th of June, however, the allied army,* without having entrenched their position or its outpost at Quatre Bras, fought the great and glorious battle of Waterloo, a "bludgeon" contest in which the cool indomitable bull-dog courage of the British infantry, cavalry, and artillery were eternally recorded in the Duke of Wellington's celebrated despatch to Lord Bathurst, dated "Waterloo, 19th June, 1815," in which, taking into consideration the peculiar circumstances of the case, he very honestly stated—

"Your Lordship will observe that such a desperate action could not be gained without great loss; and I am sorry to add that ours has been immense. . . . .

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* On the evening of the 17th, Captain Wells, R.E., received orders from the commanding Engineer to take his company to Braine-la-leud and there to make an entrenchment for the protection of the right of the position of Waterloo.

"The company" (see Captain Conolly, vol. i., p. 232) "marched the whole of the night, and was on the position when the action commenced on the morning of the 18th. After a time it was ordered to the rear by Major Sir George Hoste, R.E."

"I should not do justice to my own feelings, or to Marshal Blucher and the Prussian army, if I did not attribute the successful result of this arduous day to the cordial and timely assistance I received from them."

At Quatre Bras and Waterloo the losses of the British and Hanoverian forces, were—

	Officers, Non-commissioned Officers and Men.	Horses.
Killed	2432	2386
Wounded	9528	
Total . .	11960	

THE MINIÉ RIFLE.

"J'ai eu tort, je l'avoue, d'exposer mes pauvres soldats à un climat pareil!"

(*Napoleon's confession on reaching his own country, Mayence, after having deserted from the remains of his great Russian army.*)

It appears from the above aspiration that the cold of a Russian winter had warmed the heart of Napoleon, which under the fire of musketry and cannon had remained throughout all his campaigns, so far as regarded the lives of his soldiers, hard frozen.

To protect them from such fire by field-works never entered into his head; and indeed so little was Vauban's prescription thought of by the General of any nation, that even the great Duke of Wellington, without the slightest allusion to that infringement of the art of war which for so many years had caused throughout Europe the unnecessary sacrifice of so many lives, made before a Committee of the House of Commons the well-known declaration in honour of his brave highly-disciplined Peninsular troops, "*I could have gone anywhere and done anything with that army.*"

However, what no pen had power to remedy, and what no human voice had ventured to condemn, was suddenly expounded and explained to mankind by the hard, round, eloquent little mouth

of the Minié rifle, which, so soon as the greatest war of this world broke out among the Anglo-Saxon race in America, very quickly forced Federal as well as Confederate armies to seek shelter in battle behind long-neglected, long-discarded, long-despised field-works.

The extent to which these works were thrown up on both sides is so little known in England, and the knowledge of it is so important, that instead of weakening the evidence I have succeeded in obtaining by presuming to narrate it, I submit to the reader, as the most instructive pages in this volume, in the words of the witness himself, the following extracts* from the already quoted

REPORT OF THE CHIEF ENGINEER OF THE UNITED STATES ARMY TO THE SECRETARY OF WAR FOR THE YEAR ENDING JUNE 30TH, 1865.

"*July*, 1864. The engineers had previously constructed a system of detached redoubts and forts around the city (Washington) on a circuit of upwards of thirty-five miles. The labours of the engineers at Chattanooga had rendered this important position, as well as Knoxville, impregnable.

"*Nashville.* The importance of these defences was mainly in enabling Thomas to concentrate his army at a depôt well stored with munitions of war, and to hold his enemy, flushed with his successful march from Atlanta, in check, until he was ready to take the field.

"*Knoxville.* At this latter place the whole army was strongly entrenched.

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* In these Extracts the names of officers of Engineers employed, as also minute dimensions and details, are omitted.

"*Savannah.* The strong rebel entrenchments (here) were invested.

"*Petersburg.* On the 9th of July, orders were issued by the commanding General that 'the operations of this army against the entrenched position of the enemy defending Petersburg will be by regular approaches.'

"On the morning of the 30th, the mine was exploded. The result proved it a decided success; for in its crater were swallowed up several guns, a large number of men, an entire regiment, besides destroying the enemy's line. . . . . The grand assault was made, and the attacking column reached the enemy's line. It failed, though, to accomplish its purpose.

"The construction of works and intermediate batteries connected by infantry parapets was immediately commenced. By the 7th of September, the interior portions of the works, last referred to, were well advanced; sufficiently so to be occupied in case of an attack by the enemy, and obstructions, consisting of wire-entanglements, abattis, fraises, and slashing generally of the timber along the entire front, had been prepared. Many miles of corduroy roads and bridges had been built by the 50th New York Volunteer Engineers for the convenience and more direct communication between the different corps of the army. . . . Along every portion of the line, from the Appomattox River, below Petersburg, to the Weldon Railway, and thence back to the Blackwater Swamp, work was progressing rapidly: the length of the line was over sixteen miles, and along it had been constructed nineteen forts and redoubts, and forty-one batteries. In addition to the labour on these works, including the obstructions in their front, bomb-proof magazines, and drainage in the interior, nearly 2000 yards of roads and one-third of the covered ways had been corduroyed."

The extent of the field defences are thus described:—

"*James River.* This (defensive) line in connection with that already in course of construction, completed the chain of works from the Appomattox, below Petersburg to the Weldon Railroad, and thence back to the James River, making twenty-five miles in all, the flanks resting on the two rivers, and with them entirely encircling the army of the Potomac. . . . By this extension to the west of the Weldon railroad, eleven additional enclosed works, and several batteries, were linked with the already formidable cordon that surrounded the army. Adding to this the section to the James River, the line measured more than thirty-two miles, comprising twenty-six forts, and fifty batteries. In addition to these, there were eight other enclosed works along the inner line of the defence of the City Point.

"The works were well constructed and finished, and the infantry parapets are as strong as they could be made to answer a useful purpose. . . ."

"By the 12th November, the following extract from Special Orders, No. 306, Head-quarters of the Army of the Potomac, was issued for the information of all concerned :—

"The attention of Corps Commanders is called to the necessity of preserving in good order the entrenchments, front and rear, with the abattis, slashings, and other defences."

The conflict from the field-works of attack and defence was as follows :—

"On the 30th March, the 2nd and 5th Corps advanced their lines, driving the enemy into his main works, the two lines were within easy artillery range. *Both lines were entrenched.* [*Italics in original.*]

"On the 2nd of April, orders were issued that a simultaneous attack should be made along the entire length of the entrenched line. The assault was made, and the

exterior line of the enemy's works penetrated and possession gained of the larger portion of them. . . . The naturally very strong position at high-bridge was rendered additionally so by several redoubts which had been built there previous, for the protection of the bridge against cavalry raids.

"The army of the James, consisting of the 10th, 18th, 24th, and 25th, commanded by Major-General B. F. Butler, occupied a defensive position across the Peninsula of Bermuda Hundred on a line 6058 yards long.

"The defensive line was unusually strong. But it had also its disadvantages; for the enemy entrenched on a line approaching not nearer than 800 yards with flanks as secure as ours, and a front made unassailable by means of all the obstacles known to field defence. In addition to the line above described, there was a strong work thrown up on Spring Hill, on the south side of the Appomattox River.

"*October*. About 400 yards east of the New Market Road, a strong redoubt fifty yards square was built, and formed a salient from which the whole country within 600 yards was commanded, and from its right flank an infantry parapet of strong profile well protected from assault by abattis ran towards the New Market Road where it rested. From this point to near the mouth of Four Mile Creek strong isolated redoubts were built, and manned with troops and artillery, so placed as mutually to support each other. Along New Market Heights, the most salient points were taken and occupied by strong closed works, and in their front, for 1500 yards, the woods were 'slashed,' thus making a continued abattis in their front to the limit of the range of their artillery: works were also placed to flank the valleys and sides of these hills. . . . The details of construction were the same as generally belong to field defences, the stronger batteries being placed so as to command the most important roads

or the most probable points from which an attack would be made, with infantry parapets from four to six feet thick on top joining them."

The following is a sample of the details, devices, and difficulties in constructing the field-works above described :—

"In front were ditches from eight to twelve feet wide and six feet deep, and in advance of these a good abattis. Often the greatest difficulty has been in getting an army to take up a proper and exact line of defence at first, each regiment, company, and man digging where they find their spades, without reference to the fitness of things, indicating the necessity of more engineer officers.

"In order to save sand-bags, which at this time became very expensive, Lieutenant King, Engineer Corps, designed some loop-holes for riflemen, and for use in the picket lines, which proved admirably well adapted for their purpose, and being prepared at small cost at the saw-mills, were used on all the works and rifle pits. They were composed of boards of the form shown in the diagram. They presented a smaller target for the enemy's sharp-shooters, and at the same time gave a large field of fire. They were not easily discernible at any distance, and could easily be removed and replaced.

"The rebel device for the same purpose consisted in placing two logs of various lengths ten to fourteen inches in diameter, hewn on both sides, with notches cut in the lower side, once in about six feet, along the interior crest of the parapet, and banking these logs in front with earth. The orifice was still further reduced by a plate of thin boiler iron, eight or ten inches square, with a hole in the centre but little larger than the barrel of a musket."

The concluding remarks on details of construction are as follows :—

"The accuracy of the fire of sharp-shooters on both sides led the troops to adopt the 'head-log' on all their rifle-trenches. . . . Many miles of these 'head-logs' were examined without finding any indication that their use had been otherwise than advantageous. There was no evidence that a single man had been killed on either side by splinters thrown from them by artillery projectiles."

The important annexed report of the Instructor of Ordnance and Gunnery, dated "West Point, N. Y., June 26th, 1865," concludes with the following summary:—

"THE EXPERIENCE OF THE PRESENT WAR HAS IMPRESSED ON THE NATIONAL MIND NOT ONLY THE ADVANTAGES, BUT THE ABSOLUTE NECESSITY, OF A MILITARY EDUCATION FOR OFFICERS OF OUR ARMY."

THE BREECH-LOADER.

The great battle on the field of Königgrätz almost instantaneously caused two results.

1. On the chess-board of Europe—so far as regarded rank, power, and precedence—it made a little "king" and a great "emperor" quietly glide into each other's squares.

2. By a sort of "*sauve qui peut*" movement it made the armies of Russia, France, England, Belgium, Italy, and the United States simultaneously throw down their Minié rifles to substitute in their stead, with the utmost possible haste, another weapon.

In short, just as the persuasive eloquence of the Minié rifle had caused in the United States the rapid construction of field-works, so did its natural child, the breech-loader, in the few days' duration of the Prussian and Austrian campaign of 1866, by similar reasoning, convince the Generals and the Governments, large and small, of Europe and America, that in all the battles that had ever been fought since the invention of gunpowder the soldier had committed the strange mistake of putting his gunpowder and his bullet into the wrong end of his musket! In short, although Solomon teaches us to bring up a child in the way he should go, the soldier, by word of command, had ignorantly been ordered to "*ram down cart-*

ridge" exactly in the direction in which it should *not* go, and in which he did not wish it to go, for the simple reason that by so doing its bullet would kill him instead of his enemy.

It appears therefore that of the three degrees of comparison between the different descriptions of fire-arms above referred to, two are what may be termed known quantities; the third an unknown one.

All nations thoroughly know what was done, and what now could be done, by their troops armed with "*Brown Bess*."

They partly know, and the Americans thoroughly well know, what has been done, what can be done, and what ought to be done with the Minié rifle.

But no nation on earth knows, or is able accurately to predict, what will be the results in future great battles of the murderous fire of *breech-loading* rifles.

All that is known is that a well-disciplined, high-minded, brave Austrian army of active powerful men was first paralysed and then prostrated by the new weapon. Its power in the Abyssinian little battle of Ferogee can thus be briefly described:—

"I suppose your breech-loaders astonished 'em a little, didn't they?" was said the other day to an intelligent soldier of the 33rd.

Answer: "They astonished *US!*"

But although nothing but the actual use of the

new weapon in campaigns in different descriptions of country can test its precise power, and although in the meanwhile many crude ideas are enunciated on the subject, yet in the darkness or rather intermediate twilight that prevails, it can distinctly be perceived

1. That in future warfare cover, natural or artificial, must be much more sought for, even by the Americans, than heretofore, and that this gain on the side of "defence" against "attack" must render the Engineer service of greater importance.

2. That the French system of independent loose skirmishing order and subsequent rapid concentration, as opposed to the solid steady movements of British troops, must, generally speaking, prevent the latter from resorting to their favourite weapon, the bayonet.

3. That in fields of battle the influence of cavalry and artillery must be greatly reduced.

For, in consequence of the great precision and rapidity of the fire of breech-loading rifles and guns, cavalry will no longer dare to attack the enemy's infantry in square, or even advance against them in line, or be able to hover on a plain in a threatening manner six or seven hundred yards distant from them; but more than ever and more than others will they have either to keep at a distance, or seek undulating and broken ground to cover them.

For the very same reason artillery must not

only take up a more distant position than formerly, which in many fields of battle would not be easy, but on account of the enemy in its new extended form studiously obtaining cover, they—the artillery—in future will have very small instead of very large targets of men to expend their fire upon.

It must be evident from the above sketch that the modern weapon would sooner or later force the troops of all countries to introduce a new system of exercising and tactics, and accordingly throughout the continent of Europe this has already been the prompt and actual result.

The Army of Austria, which previous to the battle of Königgrätz had been taught that concealment was cowardice, and that to rush with the bayonet against the enemy was courage, at this moment is being instructed, under the guidance of military science, to take advantage of every inequality of ground, and by every other artifice, to seek shelter from the fire of its enemy.

To carry this system into practical effect two Generals are suddenly called upon to oppose each other in an attack and defence, of the merits or demerits of which six Generals are appointed as judges. In these important lessons there are no tawdry reviews, but men and officers in easy undress costume are encouraged to think of nothing but to learn how, by the most dexterous devices, to render themselves able to kill their enemy and shield themselves.

The Prussian Army, instead of idly "standing at ease," self-satisfied with their victories in 1866, are, with the greatest "attention," practising all and, if possible, more than the Austrian army.

In these exercises each detachment of the army, or division billeted in villages for the purpose, is every day required to cover its camp or cantonments with outposts as in actual war.

"In the manœuvres which I witnessed in 1866 (see the able letter 'from a military correspondent' in the 'Times' September 26, 1868), nearly every officer I saw had his map conspicuous under his sword-belt, and this was constantly referred to. . . . .

"An excellent system prevails of placing fresh officers in command of the two opposed detachments from day to day; thus each superior officer present gains experience of command, and the presiding General attains that knowledge of their abilities which aids him in working the system of promotion by selection, or rather by weeding out, on which the efficiency of the Prussian service so much depends.

"As to smartness these troops are not to be judged by the English eye, infantry, cavalry, and artillery are each decidedly what we should call dirty; but no one who sees them work can doubt of their soldier-like ability; whether at the manœuvre, on the march, or on outpost duty, every man seems to be 'doing all he knows,' and doing it well. 'You see that *we are in earnest in our work*,' said the General to me, and verily the earnestness displayed by officers and men alike is, as it would be called in the far West, 'a caution.' Never have I seen greater concord between the three arms of the service; no jealousies are allowed to show themselves, nor do they seem to exist. The infantry give their cover and support to the artillery,

and the hussars are everywhere, covering the ground with videttes by day, patrolling towards the enemy's outposts and learning his every movement; intelligent to a degree, knowing every village in a country however new to them, carrying written reports from the advanced posts to the reserve, remaining by ones or twos on duty all night with the infantry outposts for the same purpose, carrying orders at the manœuvres in the field, scouting on the flanks of the force, or in groups dashing in towards the enemy's line to discover his strength and position, the General is fortunate who has the services of such a light cavalry."

The French Army.—In practising field manœuvres in their instruction camp at Chalons, not only are officers and men taught the new art of war as above described, but so alive are the troops (hitherto, as described by Canrobert, prone to "rush" at their enemy) to the necessity of sheltering themselves from the desolating fire of the new weapon, that their infantry have already readily learnt how in a few hours, and almost in a few minutes, to obtain it, by throwing up a dwarf parapet just high enough to enable them when lying in its ditch on their stomachs to deliver fire without being exposed to it.

And yet, strange to say, all this so-called "*modern* science of war" is precisely that which from and probably before the days of Columbus has been the practice of the North American Red Indians, who at a meeting, which just thirty years ago I convened, of many thousands of them at the uninhabited "great Manatoulin Island," in Lake

Huron, performed before me their war dances, in which, commencing by lying with one ear on the ground, listening for the slightest movement of their supposed enemy, they crawled towards him on their stomachs, concealed themselves behind a large stone or bush, crept onwards, stopped, listened again, and so on until suddenly coming within reach of their foe up they started, fought with him—killed him of course—scalped him, the whole ending something like a glorious run with fox-hounds, with the waving of the trophy and the war "*whoop!*"

But the following extract from the 'Times' of the 1st instant (December, 1868) informs us that the very same principle of field defences in warfare is at this moment waging against us by the Maories, whom we also call "savages," at the antipodes.

"*From our own correspondent.*

"*New Zealand, October* 1.

"On the 7th of September a force consisting of 250 men and 110 native volunteers left the camp at Waihi with the view of attacking a pah at Te Ruarura, two or three miles in the rear of the pah at Ngutu-o-te-manu, then recently attacked and destroyed.

"Towards three o'clock, while crossing a gully, the forces were checked by a sharp fire from an unseen enemy, and they found themselves in the rear of Ngutu-o-te-manu, which had been re-erected. Major Von Tempskey and several of the officers counselled rushing the stockade, but Colonel M'Donnell, not seeing his way to holding it, even

if successful, declined doing so, and, endeavouring to collect his wounded, directed the forces to clear out from the gully in the only open direction that appeared practicable. The rebels kept up meanwhile a continuous fire from the tops of trees, from trees with their butts hollowed and loop-holed, from no one knew where scarcely. Von Tempskey endeavoured to remove one of the wounded and was shot dead. Captain Buck endeavoured to recover the gallant major's body, and fell over it mortally wounded. A panic seized many of the men. The new levies threw down their rifles and huddled together, making the best of their way out in any direction. Colonel M'Donnell's party, after emerging from the gully, were closed upon in their rear by the rebels, and other parties, refusing to extend and take cover, suffered much loss in consequence. The dead and some of the wounded had to be left where they fell. Among the wounded so left was Lieutenant Holland Hastings, formerly of the 14th Dragoons, and lately doing service in India. He had volunteered for three months, and with great coolness conducted the retreat of a party of 45 men, whom he had assisted in raising a couple of months previously. While retreating he was severely wounded, but to avoid increasing the panic concealed it from the men all the while it was possible to do so, and then, bidding them never mind him, but make their own way to camp as best they could, he was laid down to die. His party secreted themselves until the moon rose, and then, guided by some of the native contingent, reached camp next morning. Straggling parties had been coming in all night, and when the roll was called in the morning it was found that 5 officers and 14 men were killed or missing, and 24 wounded. None of the native contingent were wounded—a proof, Colonel M'Donnell adduces, of the necessity of warring with only such forces as have had *experience in bush life*. To this contingent it is owing that any of the forces got safe back at all.

THE BRITISH ARMY.

"The wisdom of our ancestors is the wisdom of the cradle."—
Benjamin Franklin.

In after-dinner speeches, and even in grave orations "in another place," it is usual for the War Authorities of England negatively to declare, and thereby to promulgate to the world, "that the British army was *never* in a more efficient state than at the present hour or even moment;" meaning positively that our army is now as efficient as it has ever been.

The accusation, alas! is strictly true. So far as regards the physical strength, the endurance, the indomitable pluck, the discipline of the Line, the present sum total is at least equal to that recorded in its most brilliant annals.

But, as mechanical power enables a weak light peasant either to draw towards him, push from him, lift from the ground, or throw down upon it, the strongest and heaviest man in his village, in his county, in his country, or in the world, so have the modern weapons of precision to a certain, or rather uncertain degree diminished in the British soldier the practical value of these noble attributes.

In our navy this depreciation is an admitted fact, and accordingly, instead of, as in the glorious days of Nelson, sanding the decks of a man of war,

and allowing its gallant crew to fight naked to their waists, a scientific or "skulking system" as they would have termed it, has been adopted, by which, at enormous cost, they are to be protected by iron armour-plating which literally, sometimes before it is finished, is found not only to be but little more serviceable than wood, but, from its dead weight, to be actually worse than useless.

Three or four years ago it was an almost admitted law in gunnery that a shot could penetrate an iron plate equal in thickness to its own diameter, that is to say, a 7-inch shot could penetrate 7 inches, a 13-inch shot 13 inches.

But the employment of a harder and better metal in the shot, combined with a pointed form, has lately disproved this law; and accordingly the present formula is, "*given* a pointed shot which will not break up, and the only limit to its penetration is the limit of the velocity that can be given to it." *

But while the navy, assisted by our artillery, thus day by day and hour by hour with successful energy are striving to protect the sailor, the army, as will be shown, is perseveringly adhering to the

* Until lately, a well-built ship, plated with iron armour four and a half or five inches thick, was considered impenetrable by any guns that could be brought against it, and upon this supposition the 'Warrior' and others of our armour-plated fleet were built in 1861. In the following year it was discovered that ships of this class can be penetrated by both shot and shell, which, breaking up as they pass through into countless splinters, commit havoc and destruction among the crew.

ignorant, obsolete, old English bull-dog system of open fighting as introduced by Napoleon.

Its system, in direct opposition to that of all other nations, and especially of the United States of North America, is as follows :—

At our camps of instruction—the largest, the most costly, and among the soldiers the least popular of which is Aldershot—a certain number of "field-days," commanded by a "General and brilliant Staff," afford, it is readily admitted, opportunities to commanding officers of seeing combinations of the different arms of the service, thereby teaching them to become familiar with the movements of large bodies of men. These field-days, however, are simply huge drill parades.

In the summer, in addition to them, it is the custom for a "flying column," consisting generally of about two or three regiments of Infantry, a regiment or two of Cavalry, and a proportion of Artillery and Engineers, to be detached from the division, to march to Sandhurst or Woolmer, there to encamp for two or three days and "*drill*," *i. e.* have "*field*-days" precisely similar to the ordinary Aldershot drill-days.

There is never any attempt on the part of the General, as in the great camps of Austria, Prussia, France, and Belgium, to select (which no doubt would be the case if his Assistant-Quartermaster-General was an Engineer officer) a position capable of being strengthened, or when selected, to render

it in any way defensible, either by throwing up slight field-works, by the construction of obstacles to the approach of an enemy, such as palisades, abattis, &c., or by the careful posting and protection of the different arms.

There is no attempt to amuse the men by teaching them how, by simply driving Norton's American tubes, to supply themselves with water; or by the latest improvements in camp kitchens, to avail themselves of the readiest mode of cooking their own food.

And lastly, while divisions, battalions, and regiments of all the armies of Europe, some standing, some stooping, and some prostrate on the ground, are learning by the use of the pick and shovel to protect themselves from the murderous fire of the breech-loading rifle,—while the "savages" of North America, by ingenious forest devices are still keeping, as for forty years they have kept, the United States regular army at bay,—and while the Maories of New Zealand are literally repelling and capturing Anglo-Saxon troops by the use of *their* rude field-works, so determined in the British service is the opposition to military *science*, in whatever form she may appear, that although the B Troop of the Royal Engineer Train has for several seasons formed part and parcel of these great Aldershot reviews, it has never yet been allowed an opportunity of distributing to the troops the entrenching tools which, packed in waggons com-

manded by Engineer officers, guarded by sappers, and followed by pack horses, at considerable cost to the country, have been collected and organised expressly for the rapid "CONVEYANCE OF ENTRENCHING TOOLS FOR AN ARMY IN THE FIELD." (See sketch, p. 183.)

In short, not only the apparent but the real object of our camp reviews has been and is, by the main strength and power of our War Authorities, to repudiate protection from the breech-loader, and in lieu thereof to enforce the continuance in the British army of the obsolete Brown-Bess system of "fair stand-up fighting" in an open field of battle!

Now this inconsistent system—which, scorning the use of cover found to be necessary even for troops armed with the condemned Minié rifle, purchases for them breech-loaders, and then drills them for Brown-Bess movements, that is, teaches them the art of how to get killed—inflicts, as can readily be shown, injury to all ranks from the highest to the lowest.

1. As regards the Generals and their Staffs.

One of Napoleon's instructions to his artillery was, wherever a body of Staff officers were seen congregated, to fire vollies at them, "*pour tuer quelque petit Général,*" and thereby to dislocate his proceedings.

With the present arms of precision a conspicuous target of officers would not only rapidly be mowed

down by "vollies" of artillery, but at a distance of half a mile (880 yards) a single Armstrong gun, our first-class riflemen of the Line, or of our Volunteers, including say half-a-dozen members of the English House of Commons and also of the Lords, would each, it has been accurately estimated, undertake to select and with a breech-loading rifle to hit, in two minutes and a quarter, the General commanding (or his horse), provided his feathers and trappings made him sufficiently conspicuous.

For his interest alone therefore it is necessary first, that wherever practicable he should sit on horseback, or stand alone, with his Staff dispersed within his reach. Secondly, that all distinctions of dress visible at three or four hundred yards should as quickly as possible be abolished, for the sake in the first instance of those who wear it. But in our camp reviews the abolition by Generals and their Staffs of conspicuous feathers, cocked hats, glittering ornaments, &c., and especially the sight of their General dressed like themselves, standing alone hiding himself behind a haystack, would be a most useful lesson to our infantry, for so long as they see not only artillery and cavalry but the officers they are taught to follow, needlessly and recklessly exposing themselves during breech-loading fire, it is utterly useless to try to teach them to go almost against their nature by stooping, crouching, creeping, crawling, and "sneaking," in order to conceal themselves from it.

Sir John Burgoyne, in his 'Military Opinions,' p. 286, in advocating that siege engineering duties should be assisted by "*éclat*," says—

"Works are not executed by the British in the time they should be, nor with the alacrity with which they are in other services. I have known our men (the Line) refuse to take out their gabions and set to work. . . . . I have myself placed, at different times, hundreds of gabions with my own hands, and then *entreated* the men to go and fill them, but to no purpose."

In short, in the Peninsula these noble fellows, trained to fight in the open, like the Generals who commanded them, disdained either to seek or make cover of any sort.

But, although one cannot sufficiently admire the noble sentiments of the old-fashioned British soldier, yet there can exist no doubt that if the War Authorities who command him would encourage instead of discourage science, there would very shortly be developed from both officers and men an amount of it which, as regards self-protection, has hitherto remained latent.*

If in their camps of instruction they were to be

* It is commonly believed, that one of the results of the rapidity with which the breech-loader can be fired, will be that it will tend to the men getting rid of their ammunition too rapidly, and consequently wasting it. But although this would inevitably be the case, as it was at the little Battle of Ferogee in Abyssinia, by troops uninstructed, yet it is a well-known fact that in the Peninsula "the Rifle Brigade," the only body in the army who were really instructed in shooting, fired *less* ammunition for the periods in which they were engaged than any other corps.

SO MUCH FOR EDUCATION!

taught to seek shelter along hollow roads, behind hedges, &c.,—if the walls of gardens and farm-buildings, as they passed them, were to be chalked by their officers with small circles representing the proper position for loop-holes of defence,—if the General, instead of despatching aides-de-camp across country, were to be seen communicating his orders by flag signals,—if in the midst of his operations he could despatch, by means of his travelling electric wires, a telegraphic order to the Horse-Guards, and vice versâ;—if, receiving a moderate remuneration for injury to their clothing, his men were, without being fatigued, to be instructed how to make a fascine, a gabion, how to lay the one and fill the other,—if their General, on reaching a position, would in the presence of all, selecting one regiment, give it say half an hour to protect itself by a field-work, left to be criticised, that is to be admired or condemned, for a week by other regiments and branches of the service, —the British soldier would very soon become as much distinguished for his discretion in battle as he ever has been, is, and ever will be, for his valour, or rather for his calm indomitable courage.

But instead of imparting instruction of this wholesome description by ordering say two or three engineering field-days at Aldershot every season, to enable the army to see in practice all the latest improvements in the art of war, the educated branch of the service is, to say the least, in every

way openly discountenanced. For instance, to the Line rewards are given for rifle shooting (*i.e.* man-killing); to the sapper, who distinguishes himself by pontooning, signalling, electric communication, photography, road-making, or water-boring (*i.e.* man-preserving), no such reward is allowed. In short, just as in the fifteenth century, the vicar of Croydon, in a sermon preached by him at St. Paul's Cross, in alluding to that new art to which the brief men, and especially the monks, were the inveterate opposers, exclaimed, "*We must root out printing, or printing will root us out,*" so do the War Authorities act towards the army as if they clearly foresaw from science the same result.

In the meanwhile there are two facts which I humbly submit it is impossible for any competent military authority summoned before the new House of Commons to deny:—

1. That, of the armies of Europe, that of England is at this moment, by a long interval, the most ignorant in the art of self-defence against the desolating fire of the breech-loading rifle.

2. That in its present wilful state of ignorance it is incompetent to contend against any one of those highly educated armies above referred to, in equal numbers.

PART IV.

THE INVASION OF ENGLAND.

Eighteen years ago I published a volume entitled 'The Defenceless State of Great Britain,' the desperate object of which was, if possible, to frighten the wealthiest people in this world,—unjustly designated by their enemies a nation of shopkeepers,—into the necessity of paying for that self-defence which the great Duke of Wellington and Sir John Burgoyne for many years had earnestly recommended to them in vain.

Since its publication there has arisen as it were out of the ground a volunteer force of, say 150,000, intelligent, well-educated, self-disciplined, self-taught, skilful, Minié-rifle men.

In 1850, as I demonstrated, we were destitute of the means of repelling invasion. We now *amply* possess them. The question to be considered is, how, under the circumstances of the present day, should those means be best applied? And as for some years I have reflected on this subject, I venture to submit to the reader, as relevant to the preceding chapter, the following very rough

MEMORANDUM.

As our parliamentary returns publish annually the precise amount of the naval and military forces of Great Britain;—as the composition of the heart of

the Englishman is well enough understood;—and, consequently, as the danger to a hostile army landing from boats under fire in loose detached irregular heaps in which they must remain waiting for their artillery and numerous other requirements for an advance, is apparent—it follows that in order to avoid *immediate destruction* it would be necessary for the invading army

1st. To obtain possession of the British Channel.

2nd. Under cover of the guns of its dominant navy to land and protect an overwhelming amount of military forces.

Now almost every Englishman has been educated to believe that the first of these requirements would be impracticable, and, with *time given*, so it would.

But if, in accordance with the modern system of warfare (as Prussia in 1866 dealt with Austria), *no time* should be given, it follows logically that while our ships of war were scattered over the aqueous surface of the globe, the enemy's navy, concentrated by secret orders, could for a short time occupy any one position, such for instance as the British Channel, just as certainly as our Grenadier Guards, in solid column, could take and for a short time maintain possession of any point in a line of defence occupied by both the Coldstream and Fusilier Guards, extending,—each man being more than a quarter of a mile apart,—from Buckingham Palace to Balmoral. So much for England's naval defence against invasion.

Admitting, therefore, or (if that word be too unpalatable) *supposing for a moment*, that the invaders were enabled not only to escort but, by the fire of their guns, to cover the landing of say 200,000 regular troops composed of infantry (armed with breech-loaders), cavalry and artillery in due proportions, with ammunition, stores, &c., the War Authorities of London would have to choose between two courses diametrically opposite to each other—the one centrifugal, the other centripetal; or, in plainer terms, the one the gallant old-fashioned "up and at 'em" system of *Attack* (which all our regiments would ardently desire); the other the newly revived engineering scientific system of *Defence*. By the one the military power of England would advance, by the other, after a prudent amount of resistance, it would retire.

Now, in case the latter course were to be adopted, the following sketch, in which I have selected as the field of defence a country across which I have hunted for more than twenty years, will afford an outline of what I humbly believe would probably be its details:—

TELEGRAM

To the General Commanding-in-Chief.

"The enemy's navy has possession of the Channel. Preparations have been made by him to transport, the day after to-morrow, convoyed by his navy, an invading

army complete of 200,000 regular troops, composed of infantry, cavalry, artillery, ammunition, stores, &c.

"Our immediate powers of resistance are:—

"Regular troops of all arms, with a due proportion of guns		50,000
Militia and Yeomanry		50,000
Volunteers	Riflemen, &c. (efficient)	120,000
	Horses	60,000
	Guns	100
Navvies (sworn in under martial law, commanded by Engineer officers, Royal and Volunteer)		80,000

"It is expected the hostile army will effect a landing within 20 miles from Brighton.

"The country between it and Croydon is composed of,

	Miles.	Character of country.
From Croydon to the commanding ridge of chalk hills	8	Downs and fields with hedges.
From chalk hills to Red Hill and Nutfield sand ridge ..	3	Vale, heavy land, part boggy, small enclosures.
From Red Hill to the forest ..	12	Low country, strong clay, small enclosures, deep ditches, banks and quick-set hedges, small hills suitable for redoubts.
Of the forest	8	Woody—parts cleared, hilly, boggy ravines.
Level ground	4	Low hedges and ditches, strong clay.
On to Brighton chalk Downs	8	Open country.

"It has been resolved that our forces shall act on the principle of defence, instead of attack. That London shall be considered the citadel—of which every eminence, hedge, ditch, railway, building, hollow road, stream, bog, &c. between Brighton and it shall, by the 80,000 navvies, be converted into a series of *lines* of outworks, which the enemy must successively attack, under the disadvantage that throughout his progress rifle and cannon ranges will be accurately known to the defenders—unknown to him.

"To preserve the volunteers, and most especially the regular army, for a grand resistance in a strongly entrenched position on the commanding ridge of chalk hills near Croydon, every line of outworks, one after the other, is to be abandoned before the near approach of the enemy.

"Any commanding officer who in disobedience to this order shall risk a general action or occasion an unnecessary loss of men, to be instantly superseded."

To delay as much as possible the progress of the invading army, and to inflict upon it during its progress the greatest amount of loss, consistent with the preservation of the force employed in the defence, orders somewhat similar to the following would probably be given :—

1. Select lines of position, not easily turned, with good covered retreat.

2. In their redoubts and works, as soon as guns are mounted, train the volunteers to use them.

3. Partial positions and chance obstacles not comprehended in a good *line* of defence to be unoccupied, their deceptive appearance of strength proving fatal to irregular troops.

4. In front of the successive lines of position, hedges, banks, and dry ditches, running parallel to them, and thereby affording cover to the enemy, to be levelled. *Per contrà*, hedges running at right angles to them (that is, in the direction from Brighton to London) to be banked up with earth in order to enable the defence from behind these parapets, by field guns and musketry, to assail the flank of the enemy—embarrass his communications

between his right and left—and prevent his deploying.

5. Wherever a village, farm-buildings, houses, or gardens, acting as bastions, can be brought into a line of position, its power of resistance will be enormously increased. All walls to be loop-holed.

6. The piers of viaducts, of the largest of the railway arches, and of the walled air holes of tunnels, to be mined; the main timbers of wooden bridges to be augur-holed, all loaded ready to be blown up when ordered. As the defence retires, telegraph wires, locomotive rails, provisions of all sorts, to be destroyed, and every horse to be removed.

7. Trees half cut through to be thrown across roads, especially in the forest.

8. The grand range of chalk heights which, from the upper level, overlook Sevenoaks, Westerham, Red Hill, Reigate, Dorking, and Guildford, to be strongly fortified with batteries, redoubts, and stockades, connected by trenches, and strengthened in front by palisades, abbatis, and entanglements of every practicable description. The whole arranged so as to deal a destructive fire upon the enemy, and at the same time preserve the defence from that of his artillery and breech-loaders.

9. In localities, in buildings, and wherever it would probably not be expected, gunpowder capable of being exploded by an electric wire to be properly deposited and concealed.

10. While constructing the series of lines of defence, trees, &c. to be marked with different coloured flags from which the distances to the line are to be accurately measured to a yard, and, for the following reasons, one or more cards with their distances inscribed to be distributed to every company of riflemen.

(From long-continued rifle practice it has been ascertained that a bullet fired from an Enfield rifle at an elevation calculated to hit an object 300 yards distant, after having attained its zenith, descends or drops at the rate of one yard in every 50 yards. A rifle, therefore, having been laid accurately to hit a man in his middle at 300 yards, if he advances 50 yards its bullet will pass over his head, and if he retires 50 yards will strike the ground at his feet. At 600 yards the bullet will pass over his head if he advances only 25 yards. At 900 yards a movement forwards or backwards of only 10 yards will place him in safety.

In short, the greater the distance of the moving target the more accurately must that distance be known to hit it.

The result is, that the estimated value between this accurate knowledge of distance, and ignorance of it, will be between four and five to one in favour of the defence, and between four and five to one against the invaders, tantamount to a constant moving position from Brighton to London.)

11. In all the positions of defence, latitudinal or lateral, as ammunition will be abundant, there will be no necessity for reserving fire, which, with accurately ascertained distances, will, as above explained, be unceasingly destructive; while on the other hand, as the enemy, from not knowing his distances, will probably at long ranges be afraid to waste it, his power of destruction, so long as he reserves his fire, must be *nil*.

It is reasonable to suppose that by the time the invading army had advanced within sight of the strongly entrenched line of redoubts, on the commanding ridge of chalk hills near Croydon, defended by heavy guns in position, and containing and concealing in great force regulars, militia, and volunteers, its numbers would have been reduced to that of the defence, in which case to attack and assault them would be impossible. Supposing, however, that after sustaining enormous loss they were to force the defenders to retire, on their arrival at what may be termed the latitude of Croydon, their task, hitherto difficult, would in consequence of the mixture of detached strongly built lofty villas, garden-walls, lines of houses, &c., extending all the way to London, become every quarter of a mile more and more impracticable, until, even supposing that the residue of the invaders approached their goal, they would not dare to entangle the skeleton of their forces in the intricate undermined streets and mazes of the metropolis.

The foregoing sketch, although it omits innumerable works and entanglements by which the progress of a foreign army could be impeded, will, I believe, sufficiently demonstrate the difference between repelling invasion by a series of centripetal defences, instead of by one grand decisive action on, or like the battle of Hastings in the vicinity of the sea-shore.

The advantages of the former, and the disadvantages of the latter are so apparent, that it seems really almost needless to enumerate them.

The desire of the invading army I have imagined, would, of course, be to be permitted on landing, at once to engage with a force composed of a quarter of its own amount of regular troops, encumbered, rather than assisted, by a mob of 120,000 highly intelligent rifle-volunteers, deficient in war discipline, and jammed together without elbow-room in a limited space where they must either be massacred, or, by a "bull's run" panic, run away.

In like manner the allied army—(total number transported to the East 309,268)—on approaching Sebastopol, no doubt *desired* that the Russian garrison would come out and fight them in the open country.

In like manner, Sir Robert Napier, on invading Abyssinia, no doubt *desired* that King Theodore, accompanied by his prisoners, instead of forcing the English troops to march 400 miles to Magdala,

would be pleased to come and fight them at Zoulla.

In both those instances, however, Todleben in the one case, and King Theodore in the other, required the assailants to undergo a long expensive process which, in the former case cost the Allies for the whole war, in money alone, more than 250 millions, and in the latter made her pay for the capture of 26 prisoners, many of the genus "ragamuffin," 200,000*l.* apiece.

If, therefore, London is, as has been shown, an impregnable citadel, defended by from 50 to 60 miles of outworks—if to attain these outworks, the invading army must diminish in size every day by thousands of its soldiers being slaughtered by unseen breech-loading riflemen—if on its march it can have no provisions, no ammunition but what it is able to carry, while on the other hand the defenders by railways and locomotive power of every description, are amply supplied with both:

And lastly, and above all, if from being thus scientifically delayed and impeded in its progress, the volunteer force of its enemy has not only rapidly become a *war*-disciplined army, but every hour is recruited from all parts of the United Kingdom—there can exist no doubt whatever that the invading army, before it could reach London, would have to surrender.*

* My supposed defence of England is based on the supposition that the description of arms of invaders and defenders are equal.

CONCLUDING REMARKS.

As the system above described applies as well to the surface of any enclosed country as to that of England, it cannot easily be denied that future wars must more or less be campaigns of defensive positions, and that point being given, it is not difficult to jump from it to the conclusion that henceforward armies must be commanded by an Engineer General.

That the Engineer is the best educated and most scientific man in the army will very probably be admitted; but if his only dependence be on his scientific acquirements, although valuable to consult, he may not be the best to be entrusted with supreme command.

To govern, a man must be peculiarly fitted—must have a gift for it. A clear head, quick views of sight, a ready power to comprehend the sufficiency of combinations in great and sudden enterprises, with the courage to carry them through. The Engineer, though he may have all the science in the world, may lack the very quality wanted—the genius to govern. Neither Marlborough, Wellington, nor Napoleon, were indebted to Science for their ability. Carnot, an Engineer proper, was most successful in control during the stormiest period of French history. He had a genius for management and organization, and no doubt science

much assisted him. It has been detailed that whenever Engineers in Europe, and especially in the United States, have had a chance, they have usually shown themselves competent to govern.

But the object of this volume is not to elevate the Engineer above the officer of the Line, but to induce the latter to rise, or rather the War Authorities who have depressed him to raise him, by education to his proper level, which I readily admit to be not merely to lead on his company or his regiment, but to command the army (including Engineers) of which they form the fighting majority.

All I submit, and I believe I shall not submit it in vain, is

That Engineer officers ought no longer, *on account of their education*, to be deemed incompetent to command an army in the field, or a garrison, or to undertake the whole duties of the Quartermaster-General's department.

That the nicknames by which they are at present publicly degraded in the Queen's 'Army List' should be discontinued.

That the Engineers' Ordnance Survey should no longer be excluded from the 'Army List.'

As regards the Volunteers I have but one suggestion to make, namely, that they should at once be supplied with breech-loading rifles.

In the parliamentary estimates for the year

1868-9 it appears that the British taxpayer is required to contribute

For the maintenance of the Army	..	£13,887,000
„ „ Navy	..	11,177,290
Total		£25,064,290

Now as no taxpayer wishes England to invade any country in Europe or to meddle with its affairs,—as many disapprove of the expense of defending colonies, but as all unite in wishing that their lives and property in their own country should be protected from foreign invasion, it may truly be said that the latter is the main reason for the country sanctioning an annual expenditure exceeding 25,000,000*l.* But in war, as in medicine, prevention is better than cure, and I therefore submit that if England's security from invasion rests, AS IT DOES REST, on her noble army of 150,000 Volunteers, the Imperial Parliament is at this moment rendering them *attractive* rather than *repellent* by arming them with that obsolete weapon which in 1866 caused the defeat of the Austrian Army, and which the armies of France, Austria, and Prussia well know would cause the defeat of the British Volunteers; whereas the instant it was known that they stand unassumingly on their native land armed with breech-loaders, their glorious inoffensive motto, "DEFENCE, NOT DEFIANCE," would be appreciated and significantly credited to England's account. In the meanwhile,

unless Parliament wishes to degrade and discourage the Volunteers, they should without delay be enabled to defend their country and their own lives with arms equal in efficiency with those of their comrades the soldiers of the Line, and above all, equal to those of any invading army with which both conjointly may have to engage. In short, Parliament might just as well, from economy, send these fine fellows into action with damaged condemned powder as to persist in arming and drilling them with an inferior instead of a superior description of weapon, the cost of which, viewed only as an ordinary insurance, would be a prudent investment.

Among the nations inhabiting the torrid, frigid, and temperate zones of "The Earth," there exists, however, in complexion, in religion, and in prejudices, no contrast greater than between the rule of conduct in the East End of London, and that of "another place" in its West End—as regards the single question of *Insurance*.

In our great metropolis the insurance of property, like the management of an army, is divided into a certain number of departments, the whole commanded by a Generalissimo.

The sub-divisions are :—

1. Lloyd's Registry of British and Foreign Shipping.
2. Life
3. Life, and Fire
4. Life, Fire, and Marine

} Assurance Companies.

The style and title of the Generalissimo whose

duty it is to cover by insurance from foreign invasion the *whole* property of the realm is, Her Majesty's Secretary of State for War.

Now the contrast between the rule of conduct in these retail and wholesale insurances is,

That in the former, comparatively speaking in dead silence, every single subject, animate or inanimate, previous to insurance is separately examined.

For instance—

The premiums exacted for the insurance of the lives of two young women of the same height, of the same age, of the same moral character, and born in the same village, instead of for those reasons being considered identical, depend upon the answers which not only each, but a certain number of the friends of each, are required to give respecting the condition of their hearts, their lungs, their livers, their brains, &c. Moreover they are subjected to a præ-mortem examination by the company's physician.

In like manner, two ships, or two brigs, or two schooners, of exactly the same tonnage, and painted exactly the same colour, are in dead silence subjected to the examination of a printed register, in which is recorded, in addition to their ages, all that in their construction was put into them, and all that by voyages has since been taken out of them; the latter, deducted from the former, showing their present value.

Again, in a street of houses identical in external

appearance, each is separately examined as to the thickness of its party-walls, the position of stoves, &c., &c.

Now in every one of these cases the data collected are submitted to one or other of twelve committees, averaging in number 18 (that of Lloyd's is 22), composed of merchants of first-rate character, position, wealth, experience, and ability, who, according to each case, determine the amount of premium to be exacted, not arbitrarily, but in obedience to two immutable laws, namely, *that the cost of insurance of property of every description shall increase in proportion to its value and to the dangers to which it is exposed.* But while a considerable portion of the property of the country, amounting to many hundred millions, is thus at the East End of London silently insured by English merchants, the insurance of the lives and property of the *whole realm* are, at the West End, insured from foreign invasion by no such examinations, by no such reasons, by no such rules, but simply by a beautiful wind instrument, or, in plainer terms, by a great orator, bearing the title, without the sword, of Her Majesty's Secretary of State for War, who proposes the premium of insurance, *i. e.*, the amount and description of armament required, without reference either to the amount of life and property to be insured, or to the insults and dangers to which they are liable to be exposed!

No other nation except wealthy England follows

this course; and yet, under her "Constitutional Government," the cargo of no other nation stands so much in need of an adequate amount of insurance against the sudden storms and hurricanes of war.

For instance, on the opposite side of what we call "The British Channel," the lives and property of the people are at this moment insured or defended against invasion by 600,000 highly instructed regular troops armed with breech-loaders, directed by a personage who, from his boyhood, has been a student, and lately a successful leader in war; his War Minister being an experienced General of Engineers, late the commander-in-chief of an army in the field.

On *this* side of the very same channel, the lives and incalculable wealth of the people are protected from invasion by say $\frac{1}{12}$ of that number of semi-instructed regular troops, directed yesterday by Sir John Pakington—to-day by Mr. Cardwell—to-morrow, perhaps, by a Right-Honourable Quaker—or by any other powerful orator equally unstained by Military Science of the smallest description. In fact, the practical rule (which we all well know would ruin the Bank of England, the factories of Birmingham, Liverpool, Manchester, Sheffield, Leeds, and every trade and tradesman in the United Kingdom) has been, that so soon as the new manager is found guilty of having acquired knowledge of the business which in the enjoyment of total ignorance he was suddenly called upon to

regulate, an immaculate successor is appointed,* and

"Thus on, 'till Wisdom is pushed out of life."

Now, under the above system of "English constitutional liberty" which Englishmen pride themselves in maintaining, can it be denied that when 150,000 volunteers rise up in "defence" of their undefended country, to make it—as if properly armed they CAN make it—*thoroughly safe from foreign invasion*, it would be not only a prudent but a very cheap insurance to arm them with efficient breech-loaders? And, *per contrà*, besides being an utterly useless insurance, is it consistent with the principles of 'self-government,' as represented by our new House of Commons, that the art of National Self-Defence should in England be publicly discountenanced, by our haggling before the world about the paltry difference between the low premiums of insurance requisite for arming 150,000 noble Volunteers with an efficient rifle, and for

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* "I esteem it," said good Mr. Cardwell from the balcony of the Town-hall at Oxford, in announcing to his constituents his appointment of Secretary for War—(see the 'Times' of the 23rd December last)—"I esteem it the highest honour to be connected by the ties of office with a noble service; and I assure you that I hope, I believe, and expect, that in concert with Mr. Gladstone, with Mr. Lowe at the Treasury, and with Mr. Childers at the Admiralty, we of the Military Department shall be ready," &c.

N.B.—If a nest of turtle-doves are competent to protect a great empire from invasion, how ridiculous on the other side of the channel is the picture of two War Eagles, for the same purpose, silently sitting side by side, on the same perch! And *vice versâ!*

riveting them to the dishonour of being seen fighting for their wealthy country with that obsolete inefficient weapon which, in consequence of its having proved itself to be inefficient, the United States of North America, England, and every other nation of Europe has condemned?

"O MISERI, QUÆ TANTA INSANIA, CIVES?"

APPENDIX.

APPENDIX A.

LORD WELLINGTON'S *order for the Assault upon* CIUDAD RODRIGO, *written by him on the morning of that day, while sitting on the Reverse of one of the advanced approaches.*

ARRANGEMENTS FOR THE ASSAULT.

THE attack upon Ciudad Rodrigo must be made this evening at 7 o'clock.

The light infantry company of the 83rd Regiment will join Lieutenant-Colonel O'Toole at sunset.

Lieutenant-Colonel O'Toole, with the 2nd Caçadores, and the light company of the 83rd Regiment, will, ten minutes before 7, cross the Aguada by the bridge, and make an attack upon the outwork in front of the castle. The object of this attack is to drive the artillerymen from two guns (B) in that outwork, which bear upon the entrance into the ditch, at the junction of the counterscarp with the main wall of the place; if Lieutenant-Colonel O'Toole can get into the outwork, it would be desirable to destroy these guns. Major Sturgeon will show Lieutenant-Colonel O'Toole his point of attack. Six ladders, 12 feet long each, will be sent from the engineer park to the old French guard-room, at the mill on the Aguada, for the use of this detachment.

The 5th Regiment will attack the entrance of the ditch at the point above referred to; Major Sturgeon will likewise show them the point of attack; they must issue from the right of the Convent of Santa Cruz; they must have twelve axes to cut down the gate by which the ditch is entered, at the junction of the counterscarp with the body of the place. The 5th

Regiment are likewise to have twelve scaling ladders, 25 feet long, and immediately on entering the ditch, are to scale the fausse-braie, in order to clear it of enemy's posts on their left, towards the principal breach.

The 77th Regiment are to be in reserve on the right of the Convent of Santa Cruz, to support the first party, which will have entered the ditch.

The ditch must besides be entered on the right of the breach by two columns to be formed on the left of the Convent of Santa Cruz, each to consist of five companies of the 94th Regiment. Each column must have three ladders, 12 feet long, by which they are to descend into the ditch, and they are to have ten axes to cut down any palisades which may be placed in the ditch to impede the communication along it.

The detachment of the 94th Regiment, when descended into the ditch, is to turn to its left to the main breach.

The 5th Regiment will issue from the Convent of Santa Cruz ten minutes before 7.

At the time a party consisting of 180 sappers, carrying bags containing hay, will move out of the second parallel, covered by a fire of the 83rd Regiment, formed in the second parallel, upon the works of the place, which bags are to be thrown into the ditch, so as to enable the troops to descend the counter-scarp to the attack of the breach: they are to be followed immediately by the storming party of the great breach, which is to consist of the troops of Major-General M'Kinnon's brigade. Major-General M'Kinnon's brigade is to be formed in the first parallel, and in the communications between the first and second parallel, ready to move up to the breach immediately in rear of the sappers with bags. The storming party of the great breach must be provided with six scaling ladders, 12 feet long each, and with ten axes.

The ditch must likewise be entered by a column on the left of the great breach, consisting of three companies of the 95th Regiment, which are to issue from the right of the Convent of St. Francisco. This column will be provided with three ladders, 12 feet long, with which they are to descend into the ditch, at a point which will be pointed out to them by Lieutenant Wright. On descending into the ditch, they are to turn to their right, and to proceed towards the main breach: they are to have ten axes, to enable them to cut down

the obstacles which may have been erected to impede the communication along the ditch on the left of the breach.

Another column, consisting of Major-General Vandeleur's brigade, will issue out from the left of the Convent of St. Francisco, and are to attack the breach to the left of the main breach; this column must have twelve ladders, each 12 feet long, with which they are to descend into the ditch, at a point which will be shown them by Captain Ellicombe. On arriving in they ditch, they are to turn to their left, to storm the breach in the fausse-braie, on their left, of the small ravelin, and thence to the breach in the tower of the body of the place. As soon as this body will have reached the top of the breach, in the fausse-braie wall, a detachment of five companies are to be sent to the right, to cover the attack of Major-General M'Kinnon's brigade, by the principal breach, and as soon as they have reached the top of the tower, they are to turn to their right, and communicate with the ramparts of the main breach. As soon as this communication can be established, endeavour should be made to open the gate of Salamanca.

The Portuguese brigade in the 3rd division will be formed in the communication to the first parallel, and behind the hill of St. Francisco (upper Teson) and will move up to the entrance of the second parallel, ready to support Major-General M'Kinnon's brigade.

Colonel Barnard's brigade will be formed behind the Convent of St. Francisco, ready to support Major-General Vandeleur's brigade; all these columns will have detached parties especially appointed to keep up a fire on the defences during the above.

The men with ladders, and axes, and bags, must not have their arms; those who are to storm must not fire.

Brigadier-General Pack, with his brigade, will make a false attack upon the outwork of the gate of St. Jago, and upon the works towards La Caridad.

The different regiments and brigades to receive ladders, are to send parties to the engineers' depôt to receive them—three men for each ladder.

W.

APPENDIX B.

MEMORANDUM *by the* RIGHT HON. SIR FRANCIS B. HEAD, BART., *late Captain Royal Engineers.*

LORD NAPIER OF MAGDALA AND THE CORPS OF ROYAL ENGINEERS.

His Royal Highness the Duke of Cambridge in describing in the House of Lords the operations of the Abyssinian General, lately declared that "his every step had been a success and a triumph." And WHY?

For the simple reason that before, as a Commander-in-Chief of the expedition, he took the field—as a philosopher in his study—he planned a piece of mechanism, of which every piece of military arm, every military department, and every branch of military science were the polished *wheels*, the whole to be kept in motion by one highly-tempered *main spring*.

We all remember as one of the most brilliant incidents of the Crimean war, Sir Colin Campbell's "*thin red streak*" of Highlanders.

In the Abyssinian war, Sir Robert Napier's "thin red streak" was an arterial line of communication, a few feet only in *breadth*, but in *length* extending from the Red Sea to the Amba or Citadel of Magdala.

Upon the *vitality* of this arterial line the *life* of the invading army depended.

If, throughout its enormous length, pulsation at any one point had ceased, mortification at the extremity must inevitably have ensued.

The *elasticity*, however, of this "thin red streak" was its most beautiful characteristic.

From Zoulla, in spite of physical obstructions of every description—as if by magic—it stretched itself onwards, for nearly 400 miles, through the scarped and counter-scarped gigantic outworks of the Citadel of Magdala, until within its second gate it reached the self-condemned, self-executed, ghastly corpse of Theodore. And then, as the victorious army

returned—mile by mile—it instinctively contracted, until on the embarkation of the last regiment at Zoulla, as if the Great Philosopher its master, had, with his extended hand, calmly signalled it to depart—like his army which had just sailed—IT VANISHED!

But, although for his combined science, strategy, discipline, diplomacy, and hard-fighting, he is now receiving, in the bosom of his mother-country, what is usually termed, "All the Honours of *War*," as a *Missionary* he has earned an infinitely higher and more lasting reward.

His soldiers did not—like the Crusaders—on their shoulders and shields bear the cross. He did not—like their commanders—from a series of field pulpits *preach* the Doctrines of Christianity. But he induced an army, of all creeds, to PRACTISE them.

On their march, through a region of the world in which war has always been disgraced by robbery, murder, and mutilation, he induced them "to be true and just in all their dealings." "To keep their hands from picking and stealing."

In the battle-field—to do unto their wounded enemy "as they would he should do unto them."

Bearing no malice nor hatred in his heart, in the name of his Sovereign he offered not only "to forgive the trespasses," but to give "honourable treatment" to a miscreant King, who for many years had trespassed against Her and Her subjects.

Indeed it would be difficult for our bench of bishops to select from Holy Scripture a text more fit to be inscribed upon a public testimonial to the Abyssinian General than those few affecting words of his own telegram, in which, in announcing on his march, to Her Majesty's Government, "The widowed Queen's death," he added—

"During her illness, every comfort that we could procure was supplied her, and her every wish attended to."

In like manner, it would be difficult for our illustrious Commander-in-Chief to select words of admonition more important to be read at the head of every regiment in Her Majesty's service, than those two brief sentences in Theodore's letter, in which—shortly before he gave the fatal pull to the trigger of his revolver—he wrote to his conqueror, as his last dying speech and confession, to say—

"Since the day of my birth, whenever my soldiers began to waver in battle, it was mine to arise and rally them.

"Yesterday, though I killed and punished my soldiers, they would not return to the battle.

"You have prevailed against me by people *brought into a state of* DISCIPLINE."

In short, in every point of view, the Abyssinian campaign has clearly demonstrated to all nations, for their future guidance, the beneficial and beneficent results of the union, or "Belle-Alliance," in the head of one commander, of those innumerable branches of modern science—civil as well as military—which now constitute "*The* ART OF WAR."

And sudden as a flash of lightning at midnight, this demonstration promoted the corps of Royal Engineers from darkness to daylight.

In the London War Office, strange to record, it had in former ages been a time-honoured axiom, that a practical knowledge of the attack and defence of fortified places—of the application and construction of field-works, bridges, pontoons, roads, water-supply, surveying, sketching, signalling, &c.—rendered an officer of Engineers, such, for instance, as that revered experienced veteran, Field Marshal Sir John Burgoyne, *incompetent* to command an army in the field—for the very reason expounded by Festus, when with loud voice he exclaimed, "Paul, thou art beside thyself; too much learning hath made thee mad!"

But the Abyssinian campaign, conducted throughout all its ramifications by an Engineer, has indisputably established, that in that competitive examination which in the Council of Statesmen must henceforth guide their selection of the fittest officer to command an expedition, or to defend the mother-country, the corps of Royal Engineers, thanks to Lord Napier of Magdala, *can no longer be excluded.*"

Indeed, it must be evident to all classes of people, that as the rude old-fashioned prize-fighting Brown-Bess unfortified process of war, at Waterloo, so graphically described by the exclamation—"Hard pommelling, gentlemen! we must see who'll pommel the hardest!" has, like duelling with long heavy two-handed swords, become obsolete; and, as the fire of improved mortars, cannon, rifles, and rockets is daily becoming quicker and more destructive, the Engineer's *Science*

of concealing and shielding an army in action, is the natural and necessary antidote to counteract our enemy's improvements in the *Art* of destroying it.

F. B. HEAD.

Croydon, 1868.

APPENDIX C.

From 'HART'S ARMY LIST.'

COLONEL SIMMONS was employed for three years in the disputed territory on the north-east frontier of the United States in constructing works for its defence, and in making military explorations. Happening to be in Turkey in 1853, he was specially employed by Lord Stratford de Redcliffe on several important services. Joined Omar Pasha in March, 1854; escorted the new Governor into Silistria after the former one had been killed, and was present during part of the siege of that fortress; laid out and threw up the lines of Slobodsie and Georgevo on the Danube, having entire charge of the operation, with 20,000 men of all arms under his command, a Russian army of 70,000 men being within seven miles; was present during the occupation of Wallachia, and had frequent charge of reconnaissances upon the enemy's rear; went to the Crimea in Dec. 1854, to concert with the allied commanders-in-chief as to the movements of the Turkish army; was present at the battle of Eupatoria, laid out and threw up the entrenched camp round that place; afterwards was before Sebastopol from April, 1855, until after its fall, and then went to Mingrelia, and was present at the forced passage of the Ingur, where he commanded the division which crossed the river, and turned the enemy's position, capturing his works and guns: Omar Pasha in his despatch attributed the success of the day chiefly to Lieutenant-Colonel Simmons. He served as Her Majesty's Commissioner to the Ottoman Army throughout the war, and was employed in all the negotiations having reference to the movements of Omar Pasha's army. Has received the Crimean medal with clasp, the Turkish gold medal for the Danubian campaign, the Order of Medjidie,

3rd Class, and a sword of honour from the Turkish Government; also the 4th Class of the Legion of Honour; was Her Majesty's Commissioner for laying out the Turco-Russian boundary in Asia, and granted the 2nd Class of the Medjidie by the Sultan, but was refused permission to accept it.

No. 2.

MAJOR (now LIEUTENANT-COLONEL) PRITCHARD, R.E., served during the Indian Mutiny of 1857-59 with the 23rd Company Royal Engineers, and was present at the action of Khujiva, throughout the relief of Lucknow by Lord Clyde, battle of Cawnpore on 6th December, 1857, action of Khodagunge, siege and capture of Lucknow, throughout the Rohilcund campaign, including the attack on Fort Rooya, action of Alleegunj, and capture of Bareilly, throughout the Oude and trans-Gogra campaign, including the action of Doundekera, attack on Fort Oomreah, action of Burjeedia, capture of Fort Mujeedia and affair on the Raptee near Baukee (medal with two clasps). Served during the China War of 1860, and was present at the actions of Sinho and Tangku, led the assaulting party (after Major Graham, R.E., was wounded) at the storming of the North Taku Fort, being one of the first to enter; present at the affairs of the 18th and 23rd September, and the surrender of Pekin (twice mentioned in despatches, medal with two clasps, and brevet of Major).

APPENDIX D.

MEMORANDUM *by* CAPTAIN CONOLLY, *late Quartermaster of the Royal Engineers.*

THE first company of "artificers" was founded in 1772, by Sir William Green, Chief Engineer at Gibraltar, and expanded by him into a corps in 1787. The object of its formation was to employ it, in place of high-waged civil artificers, on the fortifications at the principal ports and foreign stations, and also in the field services of war.

At every station where the British soldier has had a *locale*

this corps has served, and also in many countries where none but themselves have appeared. With distinction its detachments fought at the siege of Gibraltar, 1779-1783; Valenciennes in 1793; Martinique, 1794; Santa Lucia, 1796; Porto Rico, 1797; and Surinam, 1803. One party also gained credit for its usefulness on a mission to the Sultan of Turkey, in 1798, and did well in the action at El Hanka, under the command of the Grand Vizier. During the mutinies of 1797 the corps earned the applause of Lord Cornwallis for its loyalty in offering high rewards for the detection of men tampering with the allegiance of the troops. A detachment suffered much casualty at Ostend in 1798, and the companies at Gibraltar lost half their number during the epidemic of 1804.

From 1803 to the close of the war we trace detachments at every conceivable place at home and abroad. They were found of great use in the construction of the lines of Torres Vedras, and the defence of Cadiz. In all the Peninsular sieges they were present, from Olivença to San Sebastian, including those of Tarifa and Santona, and in almost every action from Roliça to Toulouse. In the formation of the bridge over the Adour in 1814 they were praised for their courage and exertions; and in the Washington compaign, particularly at the sieges of New Orleans and Fort Boyer, they were commended for their energy and efficiency.

In 1814 and 1815 one or more companies did excellent service at the frontier fortresses in Holland, by controlling the labours of large numbers of country people in the execution of the works; and in the action at Merxam and Antwerp, and surprise of Bergen-op-Zoom they earned high praise for their gallantry. In the campaign of 1815 several companies were distributed in the great fortresses in the vicinity of the position where the final battle was fought, ready for any siege work; but the great event of Waterloo only gave them an opportunity of showing their powers at the storming of Peronne. In 1816 a company received much credit for its conduct at Algiers, and another at St. Helena performed the last offices in 1821 to the great Napoleon.

In 1824 three companies began the survey of Ireland, and ever since have carried out the national surveys at home and in the colonies. Among special surveys may be mentioned

those of Australia, the disputed territory in the State of Maine, the demarcation of the boundary between this country and the United States, the exploration for a railway in North America, and the survey of La Caille's arc of the meridian at the Cape. Likewise, in more recent years, those of Anatolia, Bessarabia, and Jerusalem. Of special surveys at home, those of the royal domains of Windsor and Osborne for the Queen, and of Southampton, may be particularized. The drawings of these surveys, executed by sappers, are among the finest and most beautiful to be met with in this or any other country. At the measurement of Lough Foyle base only a few choice men could be entrusted with the subordinate details of the work; but the re-measurement of the base on Salisbury plain was executed by sappers alone, with singular accuracy, under Serjeant Steel. This non-commissioned officer also carried out a series of Sector observations, for determining the latitudes of various trigonometrical stations used in the ordnance survey of the British Isles. He, too, was the occupant of that wondrous crow's nest which for several months was used by him as an observatory at the top of the cross of St. Paul's during the difficult but well-done survey of the metropolis.

Two companies constructed the Rideau Canal in Canada—a vast work—from 1827 to 1831. In later days, detachments have done good service on the Euphrates, the Niger, and at Constantinople, receiving for the last gold medals from the Sultan. Equally creditable were their services in Spain, under Sir De Lacy Evans, and in Syria under Sir Charles Smith, R.E., where, at the siege of Acre, the little party of sappers behaved right gallantly. At the Cape of Good Hope one or more companies have taken part in the three Kaffir wars, receiving much praise, especially for their conduct at the siege of Congella in 1842; and also in threading the perilous pass of Koonap in 1852, in which half their number were killed and wounded. In 1843 the sappers first made acquaintance with China, and up to the present have participated with credit in all the movements, actions, and assaults against the Celestials up to the very palace of Pekin.

Sappers in 1839 had the honour of exploring New Holland, accomplishing the enterprise under unmitigated suffering and peril. For eight years a detachment was at the Falkland

Islands, where they behaved with the same zeal and spirit as if the place were as cheerful and sunny as Bath. Hudson's Bay profited by the services, for three years, of another party; and another, in 1847, went to the Arctic regions in search of Sir John Franklin. In 1853 a small party penetrated the recesses of Central Africa, under Dr. Vogel; one only of the expedition escaped murder: and in 1856 a selected few were employed in the excavations of the buried city of Teos, now Boudroun, recovering, among other *antiqua*, the tomb of Mausolus at Halicarnassus.

In 1839 and succeeding years the sappers acquired much distinction through their diving operations in demolishing stranded vessels in the Medway, in recovering guns, &c. from the wrecks of the 'Royal George' and 'Edgar,' at Spithead, and in widening and deepening the Channel of St. George's, Bermuda, for the passage of steamers of large tonnage. No less were they praised for their judicious and intrepid conduct in overseeing the relief works in Ireland during the famine of 1846; and in superintending the road-making in the Shetland Isles, to afford subsistence to the starving poor. At the great Exhibition of 1851 their usefulness and integrity earned for them high encomium from Prince Albert; and at the Palais de l'Industrie, in 1855, much praise from the Parisians for their excellent behaviour and intelligence.

At New Zealand they have taken part in the various operations for suppressing the risings of the natives. In all the colonies of Australia they have given their services in science, defence, and surveys. In superintending the details of the Sydney Mint they were commended for their ardour, integrity, and intelligence; and a company employed in founding and controlling the convict establishment at Swan River earned equal praise.

During the Russian war of 1854-55 they carried out the siege operations for the reduction of Bomarsund, in the Baltic. They were the first British troops in Turkey, and the only soldiers of the army in Circassia, Bulgaria, and Wallachia. Sapper Anderson, for valour at the battle of Giurgevo, on the 7th July, 1854, was decorated by Omar Pasha with the Order of the Medjidie, presented to him by the Sultan—an honour conferred on no other British soldier. The corps was present at Alma and Inkermann; a detachment at the bombardment

of Odessa, and a company with the expedition to Kertch. At the siege of Sebastopol, and afterwards in demolishing that great arsenal and the docks, their services were admirable; and the order books bear interesting testimony to their intrepidity, skill, efficiency, and endurance. On their return home the Queen, in 1856, inspected the Crimean companies at Aldershot. Seventeen of the bravest were presented to her. Her Majesty took their names, and had photographs of four of them placed in her collection of Crimean portraits. The medals for distinguished conduct, Victoria Crosses, Legions of Honour, and Sardinian medals, which in such numbers were distributed to the sappers, prove incontestably how brilliant and brave were their services in that arduous and obstinate struggle.

Well, may it be asked, what is a sapper? This versatile genius is, as Shakspere has already answered,—

"Not one, but all mankind's epitome,"

condensing the whole system of military engineering, and all that is useful and practical under one red jacket. He is the man of all work of the army and the public,—astronomer, geologist, surveyor, draughtsman, artist, architect, traveller, explorer, antiquary, mechanic, diver, soldier, or sailor, ready to do anything, or go anywhere; in short, he is a *sapper*.

APPENDIX E.

HISTORICAL SKETCH *of the* ORDNANCE SURVEY *of* GREAT BRITAIN *and* IRELAND, by COLONEL CAMERON, R.E., *Executive Officer at Southampton.*

THE Ordnance Survey was commenced in 1784 by a distinguished Royal Engineer, General Roy, who measured the first base on Hounslow Heath, and carried a series of triangles from thence to Dover, a base of verification being measured on Romney Marsh, by Lieutenants Fiddes and Bryce, R.E.

The next officer of the Royal Engineers employed on the Survey was Lieutenant, afterwards Major-General, Colby, who

was appointed assistant to General Mudge, R.A., then director of the Survey.

On the death of General Mudge in 1820, General Colby, at that time a captain of the corps, was appointed his successor, and soon afterwards associated with himself in his labours a considerable number of young officers of the Royal Engineers, several of whom, and especially Lieutenants Drummond, Portlock, Larcom, and Dawson, after distinguishing themselves on the Survey, subsequently rose to considerable eminence in other departments of the public service. At this period the officers were employed on the general triangulation of the kingdom, and in making the one-inch map of England and Wales; but in 1824 General Colby commenced the great survey of Ireland on the scale of six inches to the mile, and he then introduced the system of employing on the Survey large numbers of men, as well as officers, of the Royal Engineers, which has been continued up to the present time.

The survey of Ireland being completed about the year 1841, the surveying parties were removed to the north of England, and were for some years employed in surveying the counties of York and Lancaster and some counties of Scotland on the same scale as that which had been adopted for the Irish survey.

A discussion then arose as to whether the six-inch scale was the best for a national survey, and a "battle of the scales" arose, which was not concluded until three committees of the House of Commons and a Royal Commission had reported on the subject, and every authority of eminence in the country had been consulted. It was finally decided that the series of Ordnance Plans should consist of—

1. Plans of towns of above 4000 inhabitants on the scale of $\frac{1}{500}$ or 10·56 feet to a mile.

2. Plans of parishes in the cultivated districts on the $\frac{1}{2500}$ scale, or the scale of about one square inch to an acre, to be accompanied by reference books giving the areas of the enclosures.

3. Plans of counties on the scale of six inches to one mile.

4. Map of the kingdom on the scale of one inch to one mile.

The Survey department is now employed in making and publishing this series of plans, a force of 1549 persons being

engaged in the work, viz., 20 officers and 4 companies of the Royal Engineers (consisting of 90 non-commissioned officers and 272 sappers and buglers), 668 civil assistants, and 499 labourers.*

The head-quarters of the Survey is at Southampton, to which place all the plans of the Survey, except those relating to Ireland, are sent to be examined and zincographed or engraved, and where all the trigonometrical and other calculations are made. A similar establishment on a smaller scale for the Irish survey exists at Dublin, where the engraved map of Ireland is printed for sale, and where the alterations are engraved which are made in the map by an Ordnance Survey division kept constantly employed in revising the old survey and bringing the map up to the present state of the country.†

Besides the head-quarter establishments at Southampton and Dublin, there are Survey divisions at London (2), Tunbridge, Guildford, Southampton, and Chester, in England; at Aberdeen, Oban, Banff, Inverness (2), and Edinburgh, in Scotland; and at Dublin in Ireland.

The surveys are made and the plans drawn by these divisions, which ordinarily consist of an officer and 80 men, or thereabouts, of whom about one-third are Royal Engineers.

There is also among them a boundary division, whose duty is to ascertain the parish and other boundaries shown on the ordnance maps, and two divisions charged with the duties of spirit-levelling, contouring, and hill sketching.

The sappers come to the Survey after having been instructed at the Royal Engineer Establishment at Chatham, and are gradually trained to the different duties. They work side by side with civilians at the same duties in field and office,

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* An officer and 22 non-commissioned officers and men detached for the purpose of surveying the sites of new forts in Canada, are not included in this statement.

† The topographical office of the War Department at 4, New Street, Spring Gardens, is also under the Director-General of the Ordnance Survey, and has a Royal Engineer, Lieut.-Colonel Cooke, C.B., at its head. Its province is to collect the maps and military statistics of other countries, to copy and lithograph miscellaneous maps and plans for the War Office, &c.

and both are under the superintendence of the non-commissioned officers.

The civil assistants usually join the department as boys, or, in the case of the surveyors, as chainmen (labourers).

The principle of the division of labour is carried out very fully on the Survey. Thus there are some 20 processes to be gone through before arriving at the finished map, viz. :—

1. Perambulating the boundaries.
2. Observing the angles of the triangulation.
3. Calculating the trigonometrical distances.
4. Surveying.
5. Plotting the plan in pencil.
6. Examining tracings from the plan on the ground, and collecting names.
7. Drawing.
8. Computing areas.
9. Examining the finished plan on the ground (by an officer).
10. Inserting levels and contour lines.
11. Final examination of the plans at Southampton.
12. Tracing the $\frac{1}{2500}$ plans for zincography.
13. Printing the $\frac{1}{2500}$ plan from zinc.
14. Printing the area books (usually done by Her Majesty's Stationery Office).
15. Reducing to the six-inch scale by photography.
16. Tracing from photographs.
17. Engraving the six-inch map.
18. Hill sketching.
19. Drawing the hills from the sketches.
20. Engraving the one-inch map.
21. Printing from copper the six-inch and one-inch map.

The character of the Ordnance Survey, as a scientific work, has been established by the publication of a series of volumes commencing with the 'Astronomical Observations taken with Ramsden's Zenith Sector in 1842,' and ending with 'Comparisons of the Standards of Length of England, France, Belgium, Prussia, Russia, India, and Australia,' published in 1866.

The most remarkable volume in the series is the 'Account of the Principal Triangulation,' by Captain Clarke, R.E., F.R.S.,

under the direction of Lieut.-Colonel H. James, F.R.S., M.R.I.A., published in 1858, which contains an account of "all the observations and calculations" made on the Survey, and "of the figure, dimensions, and specific gravity of the earth as derived therefrom." The triangulation was commenced at the end of the last century, and was not finally completed until the year 1852. No less than 20 officers and 12 non-commissioned officers of the Royal Engineers were engaged from time to time in taking the observations, and in measuring the base lines.

The trigonometrical points were frequently on high mountains where considerable difficulties and hardship were encountered from wind and weather. At other stations, and especially in the eastern counties, high scaffolding had to be erected, and the non-commissioned officers, especially Corporal, now Quartermaster Steel and Serjeant Beaton, showed great skill and ingenuity in their construction.

In one case (on Thaxted Church) the instrument was at the height of 178 feet above the ground, being supported by a scaffolding raised from a point of the spire 139 feet above the ground, while the scaffold for the observatory was carried from the base to the top of the tower.

The sum of all the distances or sides of the triangulation is about 206,710,000 feet, or about 10 times the radius of the earth; the mean length of a side is 35·4 miles, and the longest side is 111 miles. The latitudes of 32 stations have been determined with Ramsden's and Airy's Zenith Sectors. The labour expended in the calculation of the results has been proportionate to that bestowed on the observations. It is obvious that angles taken with the most beautifully divided instruments, in the hands of the most practised observers, cannot be exactly true, and it becomes necessary to alter them slightly in order to obtain consistent results in the calculation of the sides. To satisfy all geometrical requirements, it is necessary in a triangulation that the sum of the three angles of each plane triangle should be 180°, that the sum of the angles round every observing point should be 360°, and that the lengths of every side should be the same in whatever order it may be calculated. In order to obtain this mathematical precision in the angles, Colonel Yolland, R.E., F.R.S., who was then in charge of the computations, applied a process, due

to the great astronomer Bessel, by which the most probable corrections to the observed angles of a triangulation are determined to make it geometrically true. He divided the triangulation into 23 parts and found the necessary equations of condition for each separate part. The labour of computation may be guessed from the fact that in one of these figures there were as many as 77 simultaneous equations to be solved; each set of equations was solved in duplicate, the two computers comparing their work at intervals.

The work occupied about 20 calculators 3 or 4 years to compute. The average amount of correction to the angles did not exceed 0″·6.

The accuracy of the resulting triangulation may be judged from the fact that the difference between the measured lengths and the lengths as computed through the triangulation of the two measured base lines (on Salisbury Plain and on the shore of Lough Foyle) amounted only to about five inches.*

The triangulation having been completed and calculated in this perfect manner, Captain Clarke deduced the distances between the arcs of parallel passing through the stations at which observations of the stars had been taken for latitude, and then determined the figure and dimensions of the earth corresponding best to the whole series of geodetical and astronomical observations.

The length of the longest semi-axis of the earth he found to be 20,927,005 feet, and the proportion between the semi-axis to be 280·4 : 279·4, which elements therefore represent the actual surface of Great Britain extending between latitude 49° to 61°, and over 12° of longitude. By a further calculation, combining all the best measured arcs of meridian throughout the world, he determined the semi-axis major to be 20,926,348 feet, and the proportion of the axes to be 292·26 : 293·26.

One very interesting feature in the result of the comparison

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* In 1861 the triangulation was extended across the Channel into France and Belgium, to connect with the continental triangulations, the object in view being to complete the measurement of a grand arc of parallel from Ourak on the River Oural, in longitude 58° E., to Feaghmain in the Island of Valentia, longitude 10° W. The connexion was made by English and French independently, the English observers visiting France, and the French in like manner observing at stations in England, for the purpose.

of the geodetical and astronomical results in Great Britain is the evidence afforded of the effect on the latter, not only of the inequalities of the surface, but also of the irregular densities of the masses *below* the surface. Thus at Cowhythe in Banffshire there is a local attraction or deflection of the plumb line to the extent of ten seconds to the south; a great part of which must be due either to a cavity in the earth to the north of the station, or to the existence of dense masses to the south.

An important series of observations has been made this autumn, and will be continued in the spring, with a view of tracing out the disturbance.

Quartermaster Steel and Serjeants Compton and Buckle were the observers employed.

It only remains to mention that the Survey Department has not failed to avail itself of those recent discoveries which have facilitated the art of the map-maker.

Thus the electrotyping process was early introduced at the Ordnance Survey Office in Dublin, and subsequently in that at Southampton, for the purpose of obtaining casts, or "matrices," of the copper plates of the Ordnance maps; from which duplicate plates are taken whenever the originals are worn out by printing. For want of such a process in former times, the engraved lines on many of the early plates of the Ordnance 1-inch Map of England have been to a great extent obliterated; and it has been necessary to engrave them almost *de novo*. The process has also afforded great facility for engraving alterations and additions on the plates, and has enabled copies of the plates to be obtained in different stages of engraving. Thus at the present time three editions of the 1-inch map are published—one in outline, another with hills, and a third with geological lines engraved upon it, in addition to the outline and hills.

Photography, which was introduced on the Survey by Sir H. James in 1855, has been of the utmost value in the reduction of the $\frac{1}{2500}$ plans to the 6-inch scale for engraving, and has effected a considerable saving of time and money. Lastly, the art of photozincography was brought to perfection by Sir H. James and Captain A. De C. Scott, R.E., in 1859, and although not used strictly for the purposes of the Ordnance

Survey, has been found very useful in the reproduction of foreign maps, and is admirably adapted for copying ancient manuscripts.

Three hundred facsimile copies of 'Domesday Book' have already been printed by the process, which is now being employed in copying a selection of the most interesting national manuscript records of the three kingdoms.

THE END.

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